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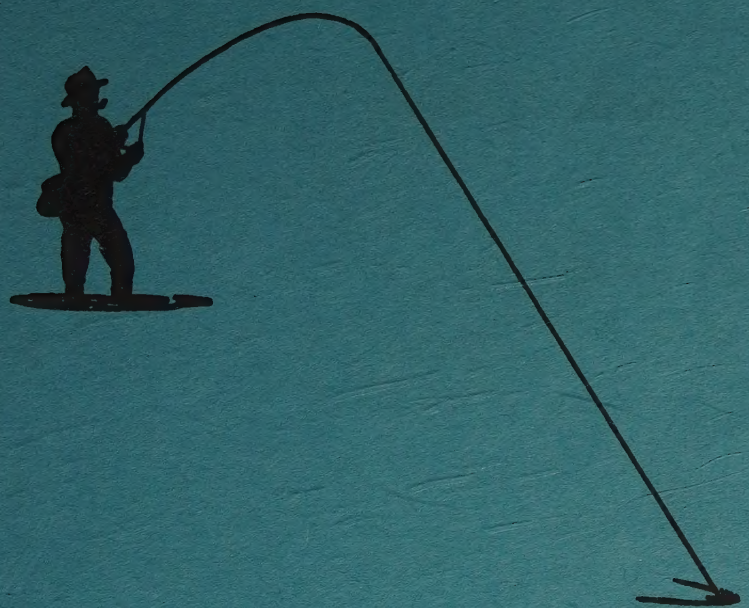
Sport Fishery Abstracts



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Sport Fishery Abstracts

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
Raymond E. Johnson, Chief
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1492. Boroughs, Howard. 1956. METHOD FOR PREDICTING AMOUNT OF STRONTIUM-89 IN MARINE FISHES BY EXTERNAL MONITORING. Science, Vol. 124, No. 3230, pp. 1027-1028.

Various organ systems and tissues of fish fed radioactive strontium-89 were analyzed for radioactivity. This was compared with the counts per minute found by monitoring the mouth, eye, operculum, gills, dorsal integument, and fins. An approximately linear relationship was found between the amount of radioactivity in the skeleton and the counts per minute in the caudal fin. This finding permits a determination of the total amount of radiostrontium in the entire fish by monitoring the caudal fin. Its one limitation is that the radiostrontium content must be in excess of a threshhold level, determined to be between 0.16 and 0.40 microcuries for this particular counting system.

1493. Winn, Howard E., and John E. Bardach. 1957. BEHAVIOR, SEXUAL DICHROMATISM, AND SPECIES OF PARROT FISHES. Science, Vol. 125, No. 3253, pp. 885-886.

Sexual dimorphism in coral reef fishes of the family Scaridae is demonstrated, based (i) on observation of spawning aggregations and other associations of the color forms recognized, (ii) injection of testosterone into females of a certain color pattern, followed by observation of the resultant male color pattern, and (iii) comparison of morphologic characteristics. The list of synonomies and the reason for each action is given for Scarus gnathodus and retula, Scarus puntulatus and croicensis, Sparisoma distinctum and aurofrenatum, and Sparisoma abildgaardi and viride.

1494. Parry, Gwyneth. 1958. SIZE AND OSMOREGULATION IN SALMONID FISHES. Nature, Vol. 181, No. 4617, pp. 1218-1219.

Three species of the genus Salmo, salar, trutta, and gairdnerii, all hatchery-raised fish of different ages and sizes, were used experimentally in batches of ten, or duplicate ones of five for larger fish, in 40-litre static tanks at constant temperature and oxygen. Dependency of age, size, and species on tolerance to salinity was studied. The smaller fish of any of the three species used were less tolerant of high salinities than were any of the larger ones. Some species difference was apparent since S. salar, 7-8 cm. long tolerated sea water better than did the slightly larger S. gairdnerii, 8-10 cm. Age alone did not account for the difference since S. salar of 3-4 cm. and of 7-8 cm., fish of the same hatching and reared in identical hatchery conditions, showed marked differences in their tolerance to sea water.

It would seem that the ability to withstand salinity changes develops gradually during the presmolt life of the fish. Whether it is complete before the smolt stage is not known. The development of regulation in the young fish may be a consequence of the development of the Keys-Willmer cells in the epithelium of the gills.

1495. Murphy, J., and J. P. Riley. 1958. A SINGLE-SOLUTION METHOD FOR THE DETERMINATION OF SOLUBLE PHOSPHATE IN SEA WATER. Journal of the Marine Biological Association of the United Kingdom, Vol. 37, No. 1, pp. 9-14.

A reagent containing sulphuric acid, ammonium molybdate and ascorbic acid may be used as a single-solution reagent for the determination of phosphate in sea water. Development of the molybdenum-blue colour is complete in 24 hours at room temperature and in 30 minutes at 60° C; the colour is stable for at least 3 days. Beer's law is obeyed closely up to at least 500 μg PO_4^{3-}-P/1. The salt error is approximately 4% with sea water of chlorinity 19.3 0/00. The interference due to either arsenate or silicate at their concentrations in sea water is negligible. (Auth. summ.)

1496. De Jong, C. M. Bungenberg. 1955. CYTOLOGICAL STUDIES ON SALMO IRIDEUS. Genetica 27 (1955): 472-483.

In fixing fish eggs to be used in chromosome research Nawashin-Karpechenko was used to advantage. The isolated germ discs were prevented from being damaged by enclosing them in agar.

In Salmo irideus the nuclear and cellular divisions proceed entirely synchronously during the first ten or eleven cleavages; phase differences will occur from about the 12th cleavage period, while at the 16th all the phases may occur side by side in one single germ disc. During the successive cleavages the nuclei and the chromosomes very gradually become smaller until a constant size is reached. Owing to these phenomena, successful chromosome research is only possible during a brief period. In the case of Salmo irideus, this falls between the 11th and the 16th cleavage period.

The cleavage rate of rainbow trout exceeds that of brown trout considerably, viz. 3 hours against 4 hours per cleavage, at 9° C. The reciprocal crosses between these two species have a cleavage rate that is identical to that of the mother species. Rainbow trout possesses 60 chromosomes of which at least 40 chromosomes have median or submedian centromeres. The proportion between the one-armed and the two-armed chromosomes highly deviates from that in the other salmonidae investigated by Svärdson. The data found in rainbow trout suggest that chromosome changes according to the Robertson law have to be accepted. (From auth. summ.)

1497. Rounsefell, George A. 1958. FACTORS CAUSING DECLINE IN SOCKEYE SALMON OF KARLUK RIVER, ALASKA. U. S. Fish and Wildlife Service Fishery Bulletin 130, Volume 58, pp. 83-169.

Cyclic fluctuations in the sockeye salmon runs of Karluk River (Alaska) coincide with those of adjacent streams, indicating that these fluctuations have a common cause. After removal from the records of the broods the variation in the returns caused by various climatic and biological factors, it is clear that the sockeye salmon have a dome-shaped reproduction curve. The general decline

in abundance can be ascribed to a lower survival rate from spawner to returning adults in recent years. There is evidence that this lowered survival rate results partially from seasonal distribution of escapement and partially from heightened mortality of the young during fresh-water residence. Smolt populations in a 15-year period, ranging in numbers from 4,700,000 to 13,200,000, show a linear relation with total weight of the whole smolt biomass indicating that within this range competition for food between young of the same brood in the lake is of no importance. At least a portion of the general decline is tentatively ascribed to heightened predation in recent years since destruction of the former cyclic character of the runs has lessened natural control of predators through a reduced amplitude of the oscillations in number of spawners. (Auth. abst.)

1498. Bridges, W. R. 1958. SODIUM CYANIDE AS A FISH POISON. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 253, 11 pgs.

Laboratory and field experiments were conducted to evaluate the use of sodium cyanide as a fish poison. At concentrations of 1 p.p.m. sodium cyanide and at a variety of temperature and pH conditions, effective kills of a number of different species of warm-water fishes were produced. The cost of the sodium cyanide was approximately 68 cents an acre foot. Application required little time and equipment. In small farm ponds the water was toxic for about 4 days.

The most significant findings of the study relate to the removal of live fishes during poisoning operations. After application of 1 p.p.m. sodium cyanide to small farm ponds, fishes began to surface within 5 to 30 minutes. Affected fishes removed and placed in fresh water completely revived within 5 to 30 minutes. The length of the removal period for centrachids was approximately 1 hour. The survival of the salvaged fishes was excellent. Many possible uses of sodium cyanide in fishery management are suggested.

Cyanides are deadly poisons. Death can result from swallowing small amounts of the salts or the acid and from breathing low concentrations of the gas, hydrogen cyanide. The greatest dangers are accidental ingestion of the salt and inhalation of the gas released by the action of an acid that has been allowed to come in contact with sodium cyanide. Sodium cyanide should be used only by technicians acquainted with it. (Auth. abst.)

1499. Gauley, Joseph E., Raymond E Anas, and Lewis C. Schlotterbeck. 1958. DOWNSTREAM MOVEMENT OF SALMONIDS AT BONNEVILLE DAM. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 236, 11 pgs.

At Bonneville Dam most downstream-migrant salmonids were caught during hours of darkness during the years 1946, 1949, 1950, and 1953. In 1952, however, the majority were day migrants. Hourly fishing in 1952 and 1953 indicated that maximum movement of chinook salmon and steelhead trout tends to occur at dawn and dusk; additional data are needed for blueback and silver salmon. Although the data are far from conclusive, the percentage of chinook salmon that migrate at night appears to be more highly correlated with turbidity than with days elapsed from start of sampling. Other factors, which undoubtedly affect day-night migration, were not tested. (Auth. abst.)

1500. Rice, Theodore R., and Rebecca J. Smith. 1958. FILTERING RATES OF THE HARD CLAM (VENUS MERCENARIA) DETERMINED WITH RADIOACTIVE PHYTOPLANKTON. U. S. Fish and Wildlife Service Fishery Bulletin 129, Volume 58, pp. 73-82.

Filtering rates of the hard clam, Venus mercenaria L., were determined by ascertaining the number of radioactive phytoplankton removed from water pumped through the filtering mechanism of the clam. If the cells are not completely filtered from the water pumped, the filtering rate of the clam is less than the pumping rate. The term "filtering rate" refers to the volume of water from which the cells are removed per unit of time.

The labeling of algae with radioactive phosphorus made it possible to follow smaller initial populations than have been used in most previous investigations, yet it provided a means of accurately measuring slight changes in these populations. The number of cells present at the beginning of an experiment and the size of these cells influenced the filtering rate. The filtering rate in unialgal suspensions was different from that in mixed suspensions. The filtering rate in natural populations of phytoplankton was higher than in unialgal suspensions of green algae and lower than in unialgal suspension of diatoms.

Silt had an adverse effect on the hard clam, since it reduced the filtering rate and stimulated the formation of pseudofeces. A similar effect was produced by the presence of Chlorella in the water. In relating filtering rates to size of clams, more water per gram of meat was filtered by small clams than by large clams. (Auth. abst.)

1501. Ahlstrom, Elbert H., John D. Isaacs, James R. Thrailkill, and Lewis W. Kidd. 1958. HIGH-SPEED PLANKTON SAMPLER. U. S. Fish and Wildlife Service Fishery Bulletin 132, Vol. 58, pp. 187-214.

A high-speed plankton sampler is described, and performance tests are discussed in this paper. The sampler was designed to supplement, and, in certain cases, to supersede standard plankton nets. The sampler is so constructed that it can be fastened to the towing cable at any point, hence samplers can be used in series to sample different depth levels simultaneously. The samplers are towed at normal ship's speed between hydrographic stations; each sampler obtains a horizontal strip sample of the plankton at the level at which it is hauled. The usual length of haul has been 10 miles. The depth sampled and the amount of water filtered by a sampler during a haul are recorded on a strip of 35-millimeter acetate film. Tests were made to determine the comparative effectiveness of high-speed samplers

and standard 1-meter plankton nets in delimiting the distribution and abundance of fish eggs and larvae. Both types of gear seem to be equally effective in delimiting the horizontal distribution of eggs and larvae. Standard nets are more versatile in depth sampling, as they can be operated to any desired depth; high-speed samplers have been operated only between about 60 meters deep and the surface, when hauled at normal ship's speed. The most marked advantage of high-speed samplers over conventional gear is that samples obtained with the former are far more representative of the mean density of plankton organisms. (Auth. abst.)

1502. Matsumoto, Walter M. 1958. DESCRIPTION AND DISTRIBUTION OF LARVAE OF FOUR SPECIES OF TUNA IN CENTRAL PACIFIC WATERS. U. S. Fish and Wildlife Service Fishery Bulletin 128, Vol. 58, pp. 31-72.

The larvae of four species of tuna--yellowfin (Neothunnus macropterus), skipjack (Katsuwonus pelamis), little tunny (Euthynnus yaito), and frigate mackerel (Auxis thazard)--are described in detail. Diagnostic characters are given to aid in the identification of the species.

The geographical and seasonal distributions of tuna larvae in equatorial waters from 1950 to 1952 are described. Yellowfin and skipjack larvae, which were the most abundant of the four species, were found to occur over a wide area between 23° N. and 15° S. latitude, from 120° W. to 180° longitude, the limits of the area investigated. The distribution was generally uniform over the entire area, but a slightly heavier concentration was noticed between 140° W. and 160° W. longitude from 5° S. to about 10° N. latitude. Although the geographical range has not been completely defined, the close adult-larva relationship points to a continuous transoceanic distribution along the equatorial currents. Both species appeared to be uniformly abundant throughout the year.

Nearly all the larvae were concentrated in the top 50 meters of water, with indications of a vertical, diurnal migration. (Auth. abst.)

1503. Dunbar, M. J. 1958. PHYSICAL OCEANOGRAPHIC RESULTS OF THE "CALANUS" EXPEDITIONS IN UNGAVA BAY, FROBISHER BAY, CUMBERLAND SOUND, HUDSON STRAIT AND NORTHERN HUDSON BAY, 1949-1955. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 2, pp. 155-201.

Results of the physical oceanographic work of the "Calanus" expeditions of 1949-55 are presented in summary. Bathymetric maps are given for Ungava Bay, Frobisher Bay and northeast Hudson Bay. Temperature, salinity and density profiles are used to show the direction of flow of water, without dynamic calculations. Temperature-salinity correlation diagrams show the presence of Atlantic water below 100 metres, well developed in Cumberland Sound, less so in Ungava Bay and Hudson Strait (but still present), and very slight in northern Hudson Bay. In Frobisher Bay the entry of Atlantic water, if it occurs, is masked by tidal turbulence. Inversions of density, giving temporary negative stabilities, are recorded at a number of stations, concentrated in the regions of large tidal ranges; association of these inversions with the state of the tide is indicated. Stability conditions of the water in general are presented; the winter regime in northern Hudson Bay offers no reason to doubt that a normal vertical exchange of water occurs. Special hydrographic conditions in certain inlets are described. The dominance of the whole hydrodynamic pattern by the tides, especially in the eastern part of the area under study, is emphasized. (Auth. abst.)

1504. Lawler, G. H., and N. H. F. Watson. 1958. LIMNOLOGICAL STUDIES OF HEMING LAKE, MANITOBA, AND TWO ADJACENT LAKES. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 2, pp. 203-218.

Heming, Home and Wapun Lakes are small, eutrophic lakes on the Precambrian Shield. They are at the headwaters of the Nelson River in northern Manitoba at approximately 55° W. longitude, 101° N. latitude. The lakes are each about one square mile in area and are all under 30 feet in depth. For four years physical and chemical studies have been conducted as part of the Triaenophorus investigation. During six months of the year the lake is ice-covered. No summer thermal or oxygen stratification is evident. Oxygen concentrations remain at a high level throughout the year. Summer water temperatures follow very closely changes in air temperature. The pH remains close to neutrality and the dissolved mineral content is about 60 p. p. m. The mineral content of these three soft water lakes is similar. Flora and fauna identified from Heming Lake include 41 genera of phytoplankton, 35 species of zooplankton, 17 genera of bottom organisms, 13 species of fish and 9 species of fish parasites. (Auth. abst.)

1505. Alderdice, D. F., W. P. Wickett, and J. R. Brett. 1958. SOME EFFECTS OF TEMPORARY EXPOSURE TO LOW DISSOLVED OXYGEN LEVELS ON PACIFIC SALMON EGGS. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 2, pp. 229-249.

Eggs of the chum salmon (Oncorhynchus keta) were exposed to various constant levels of dissolved oxygen for a period of seven days. The procedure was repeated with fresh egg samples at various developmental stages. Temperatures were constant at 10°C. from fertilization to hatching. Estimates of oxygen consumption uninhibited by low dissolved oxygen levels were obtained at various stages of egg development for whole eggs and also on the basis of the weight of larvae, excluding the yolk. Eggs were most sensitive to hypoxia between 100-200 Centigrade degree-days and compensated for reduced oxygen availability by reducing the oxygen demand and rate of development. Very low oxygen levels at early incubation stages resulted in the production of monstrosities. At about the time

the circulatory system becomes functional the compensatory reduction in rate of growth under hypoxial conditions is reduced, but eggs no longer survive extreme hypoxial conditions. Eggs subjected to low dissolved oxygen levels just prior to hatching hatch prematurely at a rate dependent on the degree of hypoxia. The maximum premature hatching rate corresponded approximately with the median lethal oxygen level. Estimated median lethal levels rose slowly from fertilization to hatching. Oxygen consumption per egg rose from fertilization to hatching while the consumption per gram of larval tissue declined from a high to a low level at about the time of blastopore closure. Subsequently, a slight rise in the rate occurred up to a level which was more or less constant to hatching. "Critical" dissolved oxygen levels were calculated and they appear to define the oxygen level above which respiratory rate is unmodified by oxygen availability. Critical levels ranged from about 1 p. p. m. in early stages to over 7 p. p. m. shortly before hatching. (Auth. abst.)

1506. Hoar, William S. 1958. RAPID LEARNING OF A CONSTANT COURSE BY TRAVELLING SCHOOLS OF JUVENILE PACIFIC SALMON. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 2, pp. 251-274.

Either individuals or schools of downstream-migrating chum, sockeye and pink salmon quickly establish a constant course in a circular channel. This clockwise or counter-clockwise course, once established, is not altered by a variety of disturbances including transfer to a channel of different size and shape or, in the case of the chum, removal from the apparatus for almost two days. The schools travel much more frequently in some particular area of a simple maze although, from time to time, they swim through all parts of it. The tendency to swim steadily forward in a winding maze seems to decline as the season of migration comes to an end. Fish trained to swim along one compass direction show no bias for this direction when given a choice of this or an alternate direction at right angles. Fish trained to reverse direction after a definite distance show a tendency to do this when given an opportunity to swim in a channel twice as long. The findings are discussed in relation to simple types of learning such as habituation, insight learning, latent learning and imprinting. The biological significance of the learning is considered in relation to the problem of migration. (Auth. abst.)

1507. Gaufin, Arden R., and Clarence M. Tarzwell. 1956. AQUATIC MACRO-INVERTEBRATE COMMUNITIES AS INDICATORS OF ORGANIC POLLUTION IN LYTLE CREEK. Sewage and Industrial Wastes, Vol. 28, No. 7, pp. 906-924.

Intensive studies were carried out on Lytle Creek to discover the effects of sewage pollution on the aquatic communities of the stream and the value of these populations as indicators of present and past pollutional conditions. In these investigations physical-chemical conditions were related to the qualitative and quantitative composition of the aquatic populations in the different life zones.

The distribution and abundance of bacteria, protozoa, and algae in the stream were largely determined by nutrients and predator-prey relations. Approximately 99 per cent of the coliform bacteria in the stream below the sewage outfall were contributed by the sewage. In the first two miles of stream below the outfall, coliforms and enterococci decreased, whereas the total bacterial population increased. Zoogloea, Sphaerotilus, and certain protozoa were most abundant in the section immediately below the sewage outfall while pollution-tolerant blue-green algae increased progressively in the pools for a distance of two miles downstream with the diatoms reaching their peak below this section.

Seasonal diurnal changes were great and were most marked in the recovery zone. Diurnal fluctuations in dissolved oxygen and pH were greatest in late spring and early summer.

Very few definite statements can safely be made concerning the indicator values of specific organisms, but definite conclusions can be formulated as to the value of certain associations or populations of aquatic invertebrates for indicating the severity and extent of pollution and the degree of stream recovery.

Clean waters were characterized by a great variety of invertebrate communities consisting of herbivores, carnivores, and omnivores; prey and predators; lung, tracheal tube, and gill breathers. In general a population containing abundant gill-breathing forms, mayflies, stoneflies, and caddis flies was indicative of clean water conditions and their absence denoted the presence of pollution and/or low oxygen. (From auth. summ.)

1508. Causey, David. 1957. PARASITIC COPEPODA FROM LOUISIANA FRESH WATER FISH. The American Midland Naturalist, Vol. 58, No. 2, pp. 378-382.

Four genera and 12 species of parasitic Copepoda are reported from 12 genera and 17 species of Louisiana fish. The species of Ergasilus are the most widely distributed and numerous of the parasitic copepods in these fish. Of these E. versicolor is the most prevalent.

Ictalurus furcatus, the blue cat, is host to the most species of parasitic copepods among the fish examined, one from each of the four parasitic genera found. The various bass are next; Micropterus punctulatus, the Kentucky bass, and M. salmoides, the largemouth bass, with three species each.

No marked host specificity is evident. Ergasilus versicolor appeared in 8 different species of fish, while Lernaea anomala and L. cruciata were in three different species respectively. (Auth. summ.)

1509. Long, Clifford W., and Raymond A. Arzylowicz. 1957. PHOTOGRAPHIC DEVICE FOR ACCURATELY MEASURING FISH. U. S. Fish and Wildlife Service Special Scientific Report--

Fisheries No. 228, 17 pgs.

A photographic measuring device using two cameras and strobe illumination has been developed to improve the accuracy of salmon body measurements in the field. The optical theory is given and the device is described in detail. The technique includes calculating longitudinal distances from photographs. The device is considered accurate with ± 0.05 centimeters when ideal subjects are measured. (Auth. abst.)

1510. Dorris, Troy C. 1958. LIMNOLOGY OF THE MIDDLE MISSISSIPPI RIVER AND ADJACENT WATERS. LAKES ON THE LEVEED FLOODPLAIN. The American Midland Naturalist, Vol. 59, No. 1, pp. 82-110.

Four lakes occupying parts of an old stream channel on the leveed floodplain of the Mississippi River near Quincy, Illinois, were selected for a study of seasonal and annual variations in the bottom fauna and plankton in relation to environmental factors. The lakes were small and very shallow, with saucer-shaped bottoms. There were no submerged or floating aquatic plants.

Dissolved oxygen was high in the winter, except when ice covered the lakes for an unusually long time. Occasional peaks in dissolved oxygen were observed in the warmer months. Turbidity was usually high except at times when ice covered the water. High concentrations of carbon dioxide occurred in winter and total alkalinity was usually above 100 ppm. Lowest pH values occurred in winter, and highest values in summer, with a range of 7.2 to 8.6.

The bottom fauna was restricted in numbers of species, but deep dredges showed that a much larger assemblage of species formerly was present. Bottom organisms, except tubificid worms, were virtually eliminated by severe reduction of dissolved oxygen during the summer, but were little affected by similar reduction during the winter. Fish predation is indicated as an important factor in holding bottom populations at a relatively low level. Maximum populations, or pulses, of the major net plankton groups were highly irregular in occurrence, and differed from year to year in size and seasonal appearance in each lake.

These lakes represent successional states in the series from a climax stream community to the terrestrial community which is initiated by the stoppage of current in the original stream. The sedimentation and filling processes which normally aid the continuation of the succession are largely inoperative in this location. Wave action on the shallow bottom, and the activities of bottom-feeding fishes have maintained a partial climax condition and the lakes are at present in a condition of successional semi-statis. (Auth. summ.)

1511. Winn, Howard E. 1958. OBSERVATIONS ON THE REPRODUCTIVE HABITS OF DARTERS (PISCES-PERCIDAE). The American Midland Naturalist, Vol. 59, No. 1, pp. 190-212.

The reproductive behavior in the field and in aquaria is given for fourteen species of darters. The observations are compared with those of previous investigators.

The darters are grouped on one basis into those species which spawn in gravel, on plants, on the side of rocks and on the undersurface of rocks. The male is on top of the female when eggs are laid in all the species except those which lay small masses of eggs on the underside of rocks. Here the male is beside the female. The effects of the substrate, size of aquaria and the number of individuals or variations of behavior are briefly discussed.

The variation in the expression of territoriality, sex recognition, and other traits is discussed. (Auth. summ.)

1512. Adams, Thomas, and William A. Hiestand. 1958. THE ICHTHYOKINOMETER, AN IMPROVED ICHTHYOMETER FOR STUDYING ACTION OF CHEMICAL AGENTS QUANTITATIVELY IN FISH. The American Midland Naturalist, Vol. 59, No. 1, pp. 254-255.

A method is described for recording the activity of fish. It consists of a modification of the ichthyometer and permits quantitative as well as qualitative recording of the influence of action of chemical agents on activity of fish. Because all movements of the fish are recorded vertically instead of in a curvilinear fashion, the amount of movement can be measured quantitatively with a planimeter. The device has been called an ichthyokinometer. (Auth. summ.)

1513. Lake, J. S. 1957. TROUT POPULATIONS AND HABITATS IN NEW SOUTH WALES. Australian Journal of Marine and Freshwater Research, Vol. 8, No. 4, pp. 414-450.

Surveys of most of the trout waters in New South Wales have been made. Relevant data of the trout areas are given in respect to geography, generalized topography, and climate. Chemical and physical conditions of the waters are tabulated. Growth rates of trout and quantitative data on the bottom fauna of some streams have been determined. It is shown that the biological, chemical, and physical characteristics of the trout habitats are related and interdependent to a marked and consistent degree. The waters are separated into three groups on the basis of trout growth. The data suggest that the majority of waters in New South Wales often provide conditions which are limiting for trout.

Preliminary population and mortality studies have been made on small sections of nine rivers and on one small lake. The results of a creel census are given. The information from these sources confirms conclusions obtained from the habitat surveys. In addition evidence is presented indicating that certain management procedures should be modified. These include legal length, closed season, and stocking of streams. It is suggested that some of these modifications would have the additional benefit of reducing predation, and that hatchery-reared trout could be utilized on a much wider basis than at the moment for cold-water fish farming. (Auth. summ.)

1514. Nichols, A. G. 1957. THE TASMANIAN TROUT FISHERY. I. SOURCES OF INFORMATION AND TREATMENT OF DATA. Australian Journal of Marine and Freshwater Research, Vol. 8, No. 4, pp. 451-475.

This paper is a general introduction to a series dealing with the state of the trout fishery in Tasmania. Methods of collecting and analysing information are described, and the general scope of the survey is outlined.

The examination of a large number of scales in relation to the length of fish has shown that scales normally appear when the fish are about 3·5 cm in length. They grow rapidly at first and quickly establish a straight-line relationship between fish length and scale length.

Tagging tests carried out on small fish have shown that a large proportion of fish under 14 cm are unable to carry jaw-tags for more than 2 months. This is related to the relative weight of fish and tag in water, when the fish weight is reduced to about one-twentieth of its weight in air, and the tag is thus heavier than the fish.

Experimental work on selective breeding failed to yield significant results, probably owing to nutritional deficiencies associated with hatchery rearing.

The growth of individual brown and rainbow trout in relation to temperature was followed for about 3 years. (Auth. summ.)

1515. Moore, H. B., and E. G. Corwin. 1956. THE EFFECTS OF TEMPERATURE, ILLUMINATION AND PRESSURE ON THE VERTICAL DISTRIBUTION OF ZOOPLANKTON. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 6, No. 4, pp. 273-287.

Thirteen 24-hour plankton stations were worked in the Florida Current and counts made for four species of siphonophores. Depth, temperature and illumination data accompanied all net hauls. An equation is developed relating the depth of each species at any given time to external conditions of temperature, illumination and pressure. This involves null value of each at which there is no stimulus to vertical movement, and factors giving relative response to each of the three environmental influences. The nulls are not solved here; the factors show a diurnal rhythm and also a progressive change from predominance of light control in the upper part of the population to predominance of temperature control in the lower part. (Auth. abst.)

1516. Chew, Frank. 1956. A TENTATIVE METHOD FOR THE PREDICTION OF THE FLORIDA RED TIDE OUTBREAKS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 6, No. 4, pp. 292-304.

Terrigenous nutrient supply in a mass of water of estuarine origin as a significant parameter in Red Tide outbreak is further studied. A relationship between an estuarine mass, carrying the nutrient supply, and the ambient environment is suggested. This relationship is applied to the Florida Red Tide with the help of a new hypothesis of Red Tide outbreak. (Auth. abst.)

1517. DeSylva, Donald P. 1957. STUDIES ON THE AGE AND GROWTH OF THE ATLANTIC SAILFISH, ISTIOPHORUS AMERICANUS (CUVIER), USING LENGTH-FREQUENCY CURVES. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 1, pp. 1-20.

Length frequencies of 8630 young to adult Atlantic sailfish, Istiophorus americanus, from southern Florida, the western Bahamas and the Gulf of Mexico were plotted by month for a three-year period. Growth is rapid during the apparently short life span, and fish hatched in June appear to reach a modal value of about 56 inches total length by November, at which time they weigh about seven pounds. At one year they have increased to 72 inches and an average weight of 21 pounds. By their second summer they are about 85 inches long and weigh about 43 pounds. The length increment drops off rapidly, and by their third year sailfish are about 92 inches long, with an average weight of 63 pounds. Interpretation beyond this point is difficult, but apparently few fish reach four years of age. There is great variation in weight for a given unit of length, particularly in the longer specimens. A 92-inch fish may weigh from 42 to 109 pounds, with an average weight of 63 pounds. An apparently high natural mortality in this species is reflected in the occurrence of only two major year classes in the sport fishery during any one month. During the winter months nearly half of the sport fishery is composed of six-month old fish. The conservation value of a Florida law that now prohibits the possession of more than two sailfish is questioned. It is suggested that tagging experiments now in progress be confined largely to the smaller specimens. (Auth. abst.)

1518. Hela, Ilmo, Clarence A. Carpenter, Jr., and J. Kneeland McNulty 1957. HYDROGRAPHY OF A POSITIVE, SHALLOW, TIDAL BAR-BUILT ESTUARY (REPORT ON THE HYDROGRAPHY OF THE POLLUTED AREA OF BISCAYNE BAY). Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 1, pp. 44-99.

In connection with a study of pollution in Biscayne Bay, at the southeastern tip of the Florida peninsula, special attention has been given to the hydrography of the area. Generally, in studies of the ecology of tidal estuaries, the exchange of waters is of great significance in determining the character of the environment. Without a proper hydrographic investigation of the estuarine character of the area, it would be difficult to establish logical conclusions from the biological or bacteriological data.

Another reason for this hydrographic study was the fact that very few investigations of water circulation in shallow, bar-built estuaries, such as Biscayne Bay, have been performed. Due to the complexity of Biscayne Bay, all rigorous model

estuaries would fail to apply to it. Therefore the hydrographic aspects present a specially difficult problem. Nevertheless, by means of carefully planned observations a reasonably clear understanding of the water exchange in Biscayne Bay has been reached.

Biscayne Bay is classed as a positive, shallow, tidal bar-built estuary, and the area studied is described in detail. Factors affecting the water circulation are discussed and special attention given also to the discharge of Miami River.

When the summer pollution situation of 1954 is compared with that of 1949 it is found that, due to the abnormally high summer river water discharge of 1954, pollution is less severe than would have been expected, except for the area close to and south of the mouth of the Miami River.

The general tidal conditions in Biscayne Bay are discussed as a basis for the tidal study of salinity and of the per cent saturation of dissolved oxygen. The horizontal salinity and dissolved oxygen distributions are discussed and their relationship studied. The horizontal distribution of per cent saturation of dissolved oxygen at different tidal phases is given. Corresponding studies of surface currents and surface salinities are explained.

The ratio between the tidal prism volume and the mean river water discharge is found to be around 24.

Finally the flushing number has been computed for the part of Biscayne Bay between Miami River and Government Cut and a most probable value of 0.3 has been derived. (Auth. abst.)

1519. Bsharah, Lewis. 1957. PLANKTON OF THE FLORIDA CURRENT V. ENVIRONMENTAL CONDITIONS, STANDING CROP, SEASONAL AND DIURNAL CHANGES AT A STATION FORTY MILES EAST OF MIAMI. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 3, pp. 201-251.

This is a survey of the standing crop of plankton in the Florida Current, its vertical, seasonal and diurnal changes, and of relevant environmental conditions. The top 100 meters is considered to be the euphotic zone. Most of the phytoplankton is nannoplankton and is concentrated in the euphotic zone, where it shows some seasonal change. Zooplankton also show a small seasonal change and a marked diurnal migration in the euphotic zone. Details are given for siphonophores, chaetognaths, copepods, euphausids, pteropods and young fish. There is some seasonal fluctuation in the total phosphorus content of the euphotic zone, and most of the phosphorus is in the form of dissolved organic matter. A smaller fraction comprises live nannoplankton and detritus, and a very small fraction is due to zooplankton. Both the inorganic phosphorus and inorganic nitrogen are extremely deficient at all times in the euphotic zone. (Auth abst.)

1520. Sparks, Albert K. 1957. SOME DIGENETIC TREMATODES OF MARINE FISHES OF THE BAHAMA ISLANDS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 3, pp. 255-265.

During late February and early March, 1952, 25 fish of 17 species were collected from the areas of Nassau and Eleuthera, Bahamas, and examined for digenetic trematodes. Fifteen of the species, including 21 individuals, harbored digenetic trematodes. Twenty-three species of trematodes were identified, 16 new host records were established, and a new record for the Atlantic Ocean of a species described from the Pacific Coast of California was cited.

A close relationship between the trematode faunas of the Dry Tortugas, Florida, and the Bahama Islands was found; a much closer relationship than occurs between the faunas of the Dry Tortugas and Bermuda or the faunas of the Bahama Islands and Bermuda. (Auth. abst.)

1521. Robins, C. Richard. 1957. EFFECTS OF STORMS ON THE SHALLOW-WATER FISH FAUNA OF SOUTHERN FLORIDA WITH NEW RECORDS OF FISHES FROM FLORIDA. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 3, pp. 266-275.

The passage of storms or persistence of onshore winds result in turbulent conditions in shallow, inshore waters and in fish kills of varying intensity. Species of fishes not normally found in shallow exposed locations may become established in such a habitat during periods or seasons of calm weather. These species are unable to withstand turbulent conditions and are killed apparently due to erosion of gill filaments by accumulated sediments. The importance of storms as a limiting factor in the shoreward distribution of many fishes is noted. The specimens collected after a storm kill in the region of Miami, Florida, include several species previously unrecorded or of rare occurrence in Florida waters. Otophidium grayi is shown to be a species distinct from O. omostigmum with which it had been previously synonymized. (Auth. abst.)

1522. Moore, H. B., and D. L. O'Berry. 1957. PLANKTON OF THE FLORIDA CURRENT IV. FACTORS INFLUENCING THE VERTICAL DISTRIBUTION OF SOME COMMON COPEPODS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 4, pp. 297-315.

The diurnal migration of sixteen species of copepods was studied at eleven 24-hour stations in the Florida Current off Miami. The extent and direction of their diurnal migration was shown to be related to their day level. In the daytime a deep-living species was more vertically dispersed, and was found at a wider range of temperature and light conditions than a shallow-living species. Night levels were controlled largely by temperature, but the light effect was sufficient to cause all species to be more abundant at the surface on moonlit than on dark nights. In Bermuda, and at the 10-15 mile station, where all species occur at relatively shallow depths, the strength of this moonlight effect is greater for deeper-living than for shallow-living species. At

the 40-mile station, where all species characteristically live deeper, the moonlight effect is greater for the shallow-living than for the deep-living species. The significance of temperature in the control of night levels is discussed in connection with geographical distribution. A diurnal rhythm in the effects of the temperature and light stimuli is suggested by the date. (Auth. abst.)

1523. Bein, Selwyn Jack. 1957. THE RELATIONSHIP OF TOTAL PHOSPHORUS CONCENTRATION IN SEA WATER TO RED TIDE BLOOMS. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 4, pp. 316-329.

An examination of existing published and unpublished data concerning total phosphorus concentration before, during, and after Red Tide outbreaks was undertaken.

The literature and earlier data have indicated that abnormally high phosphorus content is frequently associated with plankton blooms. An examination of all available data reveals that this is not so in the case of Red Tide outbreaks off the west coast of Florida.

It was concluded that waters of the west coast of Florida maintain a sufficient phosphorus content to support a Red Tide at all times of the year and that fluctuations in this have no direct value in predicting outbreaks. (Auth. abst.)

1524. Gibbs, Robert H., Jr. 1957. PRELIMINARY ANALYSIS OF THE DISTRIBUTION OF WHITE MARLIN, MAKAIRA ALBIDA (POEY), IN THE GULF OF MEXICO. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 7, No. 4, pp. 360-369.

Records of white marlin, Makaira albida (Poey), from long-line stations of the Fish and Wildlife Service M/V Oregon indicate a concentration of this species in the Mississippi delta region in midsummer, followed by a gradual dispersal to other parts of the Gulf of Mexico. In April and May the marlin again move northward. The northward distribution and migration appears limited by the 75° surface isotherm. There is no evidence of correlation of either presence or abundance with depth of water. Some distributional similarities between white marlin and yellowfin tuna are noted, and a few pertinent literature references mentioned. The need for further study is emphasized. (Auth. abst.)

1525. Schumacher, R. E. 1958. EXPERIMENTAL FEEDING OF A PELLETED TROUT FOOD TO LARGE FINGERLING AND YEARLING BROOK, BROWN, AND RAINBOW TROUT, 1955-1956. Progressive Fish-Culturist, Vol. 20, No. 2, pp. 51-57.

A pelleted dry trout food was compared to the meat-and-cereal diet of general use in Minnesota trout hatcheries. Growth rates, food conversion ratios, RBC levels, hemoglobin levels, "condition factor," mortality, and feeding costs with the two diets were compared for each of the three trout species. Growth rates for the pellet feed were good and comparable to the regular diet by Chi-square tests. The amount of food required to produce 1 pound of trout was consistently lower for the pelleted diet. For each pound of weight gained, brook trout required 1.69 pounds of pelleted food or 2.59 pounds of regular diet; brown trout, 1.38 pounds of pelleted food or 2.36 pounds of regular diet; rainbow, 1.86 pounds of pelleted food or 2.60 pounds of regular diet. RBC and hemoglobin levels were sufficiently high for both diets and all species to prevent anemia. For each given length, all trout fed the pelleted diet were heavier than those fed the regular diet. Food and preparation costs per pound of trout produced on the pellet diet were $0.212 for brook trout, $0.173 for brown trout, and $0.234 for rainbow trout. These costs were reductions of 23.6%, 31.6%, and 16.3%, respectively, for the three species. Mortality rates were negligible for all species fed either diet. It was concluded that the pelleted dry trout food could be used successfully to replace the fresh meat-and-cereal diet for these three trout species if the trout were at least in the advanced fingerling stages or larger than 25 fish per pound. (Auth. abst.)

1526. Burrows, R. E. 1958. LIGHT AS A FACTOR IN ACCELERATING THE SPAWNING OF BLUEBACK SALMON. The Progressive Fish-Culturist, Vol. 20, No. 2, p. 57.

A three-year study of the effects of light on the sexual maturation of adult blueback salmon revealed: (i) salmon exposed to almost continuous artificial light for more than a month during the 1955 experiment spawned a month later than the salmon in the open pond. Eggs of the delayed group were smaller than those of the control group, but the mortalities were comparable. (ii) Salmon exposed to 9.25-hour periods of artificial light during the 1956 experiment spawned 19 days earlier than the control group. Female mortality was lower in the reduced-light group; egg and fingerling mortalities were significantly higher in that group than in the control. (iii) Salmon exposed to 1-hour periods of artificial light for the 1957 study spawned 14 days earlier than the control salmon. Female mortality was higher and green-egg mortality significantly higher in the reduced-light than in the control. (iv) Light, not temperature, apparently was the prime factor in accelerating or retarding sexual maturation. The control salmon spawned at essentially the same time each year, though the temperature was 2.5° lower in 1955 than in 1956 and 1957. Salmon exposed to artificial light spawned at temperatures 5° lower in 1955 and 2° higher in 1956 and 1957, as compared to temperatures for the controls.

1527. Phillips, A. M., Jr., and D. R. Brockway. 1958. THE INORGANIC COMPOSITION OF BROWN TROUT BLOOD. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 58-61.

The serum of brown trout blood was analyzed for nine inorganic constituents. The serum was found to contain (in mg. per 100 cc. of serum) 0.25 mg. iron, 424 mg. chloride, 358 mg. sodium, 2.3

mg. magnesium, 20.1 mg. potassium, 12.5 mg. calcium, 9.3 mg. inorganic phosphate, 21.2 mg. total phosphorus, and 0.8 mg. sulfate. In addition, when whole blood was analyzed for iron and copper, 29.4 mg. iron and 0.28 mg. copper per 100 cc. of whole blood were found. These results show similarity to the inorganic composition of the blood of carp and human beings. (Auth. abst.)

1528. Mullan, James W. 1958. STUDY OF TAG LOSS AND EFFECTS OF JAW TAGS ON BROOK TROUT. The Progressive Fish-Culturist, Vol. 20, No. 2, p. 61.

Four hundred brook trout, half of which were jaw tagged, were placed in a hatchery pond. Nine months later, 126 tagged trout which had grown from 8.07 to 10.95 inches and 144 untagged trout which had grown from 7.91 to 11.70 inches were recovered. Only three tags, or 1.5% percent, were shed. Field observations of liberated tagged trout indicated a tag loss of about the same magnitude. Of 179 trout that were taken in population studies 4 to 6 months after they had been tagged and stocked, 3 or 1.6 percent had lost their tags.

1529. Grassl, E. F. 1958. RELATION OF A DRY PELLETED RATION TO NUTRITIONAL ANEMIA IN BROOK AND RAINBOW TROUT. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 62-65.

Groups of 1,000 to 4,000 hatchery-reared rainbow trout (Salmo gairdneri) and brook trout (Salvelinus fontinalis), 3 to 5 inches long and 9 months old, were fed a dry pelleted ration, with and without raw meat supplements. After 1 year or longer, the erythrocyte counts of these fish were very similar to erythrocyte counts of trout in control groups on a diet of raw beef liver. Neither species developed nutritional anemia when fed the dry pelleted diet, with or without raw-meat supplementation. (Auth. abst.)

1530. Allison, L. N. 1958. MULTIPLE SULFA THERAPY OF KIDNEY DISEASE AMONG BROOK TROUT. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 66-68.

Kidney disease was identified for the first time in Michigan among brook trout at two State fish hatcheries. From one lot of brook trout infected with kidney disease, 4 groups of 400 fish each were treated with various combinations of sulfamerazine, sulfaguanidine, and sulfadiazine, with 1 group receiving all 3 drugs; a fifth group of 400 fish was held without treatment for control. All treated groups demonstrated significantly less posttreatment mortality than the control group. Sulfamerazine alone was as effective as any combination of sulfas, but none of the treatments completely eliminated the disease. These tests were made at the Marquette hatchery, March 12 to May 1, 1956. (Auth. abst.)

1531. Webb, R. T. DISTRIBUTION OF BLUEGILL TREATED WITH TRICAINE METHANESULFONATE (M.S. 222). The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 69-72.

In an attempt to increase the number or pounds of bluegill which could be carried on distribution trips, field tests were conducted to determine the value of M.S. 222 under actual distribution conditions. The most promising concentrations were 0.1 gm. of M.S. 222 per gal. of water; 0.05 gm., which affected the fish slightly if at all; and 0.2 gm., which caused the fish to lose their equilibrium. Though some extremely heavy loads of bluegill were hauled, the most successful tests could not be duplicated, and at times the fish in the control loads seemed to carry as well as the drugged fish. (Auth. abst.)

1532. Carlander, Kenneth D., Charles J. DiCostanzo, and Raymond J. Jessen. 1958. SAMPLING PROBLEMS IN CREEL CENSUS. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 73-81.

A review of creel-census methods now in use emphasizes the need for more attention to problems in sampling. Only when sampling is done according to some statistical scheme can reliability of the data be measured and certain biases be avoided. The sampling scheme should take into account hourly, daily, and seasonal differences in fishing pressure and success and the geographical distribution of the fishermen. Fishing success of fishermen contacted during fishing may be the same as, or may differ from, that of fishermen contacted at the end of their trip. Sometimes fishing pressure and/or success can be estimated in more than one way, and such parallel estimates may be valuable evidence as to the validity of estimates. (Auth. summ.)

1533. Schafer, H. E., Jr., and D. W. Geagan. 1958. REPORT ON OPERATION OF THE LAKE CHICOT FISHWAY. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 82-88.

A two-year study was made of a fishway on a shallow warm-water impoundment in Louisiana to ascertain whether the warm-water fishes congregated below the spillway every spring would use such a structure. Fourteen species used the fishway to enter the impoundment. The number of fish using the structure in 1955 was 13,136; in 1956, the total number was 5,623. Even though the total numbers of fish differed, the percentages of the various species remained nearly the same. In both years, bluegill composed almost two-thirds and gizzard shad and threadfin shad combined composed one-fourth of the total number of fish using the fishway. The only species which did not use the fishway in both years were the warmouth, yellow catfish, freshwater drum, and black bullhead. Of the 760 fish tagged, 22 returns were received. The fishway was used a second time by 1.8% of the tagged fish. The authors believe that a structure like this is not desirable for an impoundment of this type. (From auth. abst.)

1534. Muncy, R. Jess. 1958. TRAMMEL NET INCREASES SAMPLING EFFICIENCY OF THE

ELECTRIC SHOCKER. The Progressive Fish-Culturist, Vol. 20, No. 2, p. 88.

Using trammel nets to encircle areas to be shocked greatly increased the number of fish taken. In particular the method seemed quite effective in taking flathead catfish from sheltered areas. Water currents and floating debris presented a problem in maintaining the net, cleaning often requiring more time than the rest of the operation alone.

1535. Lawrence, J. M. 1958. FURTHER INVESTIGATIONS ON THE USE OF DELRAD AS AN ALGAECIDE IN FISHPONDS. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 89-91.

Concentrations of 0.25 to 0.3 p.p.m. dehydroabietylamine acetate (Delrad) will temporarily control Pithophora in ponds, but its effects are of short duration (1-3 weeks). As many as 3 applications of Delrad at a concentration of 0.3 p.p.m. (active ingredient) in bass brook ponds did not affect spawning of bass, hatching of eggs, or survival of fry and small fingerlings. As many as 4 applications of Delrad at a concentration of 0.3 p.p.m. (active ingredient) did not affect reproduction or production of bluegill in experimental ponds. (Auth. abst.)

1536. Wolf, K. E. 1958. MORE DRUGS TESTED FOR CONTROL OF KIDNEY DISEASE. The Progressive Fish-Culturist, Vol. 20, No. 2, p. 91.

Selected on the basis of in vitro effectiveness, six drugs were fed for 21 days to brook trout that had been infected experimentally with kidney disease. Mortalities occurring within a three-month period after the treatments with these drugs had been stopped ranged from 11 percent for Erythromycin to 78 percent for Phenoxyethanol. Fish treated with MK-51 suffered a 65 percent mortality, those with Sodium Penicillin G a 59 percent mortality, those with Kynex a 39 percent mortality, and those with Gantrisin a 74 percent mortality. Untreated controls suffered an 83 percent mortality. Only fish that had received erythromycin were saved for further observation.

1537. Buscemi, Philip A. 1958. APPARATUS FOR TAKING NEAR-BOTTOM WATER SAMPLES IN LAKES. The Progressive Fish-Culturist, Vol. 20, No. 2, pp. 92-96.

The sampler described incorporates a number of innovations, is inexpensive to build, and may be of interest to others who are working on the benthos. The operating principle of hydrostatic pressure gradient is employed. Sizable water samples at a distance of only 1 to 10 centimeters above the substratum may be taken. Design dimensions for construction are given.

1538. Jensen, A. C. 1958. A TAG HOLDER FOR USE IN THE FIELD. The Progressive Fish-Culturist, Vol. 20, No. 2, p. 96.

This holder for Petersen disc tags consists of two thicknesses of perforated sheet aluminum riveted together for added rigidity and backed with two thicknesses of burlap which when wet securely holds the pins thrust through the perforations. The holder may be fastened to a measuring board.

1539. Wolf, Ken, and C. E. Dunbar. 1958. AN EXPLANATION OF THE PRINCIPLES AND METHODS OF TISSUE CULTURE. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 3-7.

A brief semipopular presentation intended as an introduction to a series of reports wherein methods of tissue culture are used in research on diseases of fish. (Auth. abst.)

1540. Clemens, H. P., and K. E. Sneed. 1958. THE CHEMICAL CONTROL OF SOME DISEASES AND PARASITES OF CHANNEL CATFISH. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 8-15.

The median lethal dosages and the limits of tolerance of fingerling channel catfish in pyridylmercuric acetate (PMA), trypaflavine (acriflavine neutral), acetic acid, malachite green, formalin, and phenylmercuric acetate (Tag) are reported for various exposure times from 1 to 96 hours. Two ppm. of PMA for 1 hour controlled gill diseases, Trichodina, Costia, and Ichthyophthirius if applied daily for the duration of the life cycle. Colponema and Scyphidia could be eliminated with 2 ppm. of phenylmercuric acetate applied for 1 hour; or Colponema could be eliminated with 4 ppm. of trypaflavine applied for 4 hours and Scyphidia with 2 ppm. of trypaflavine for 24 hours. Colponema could also be controlled with a 1:500 dip of glacial acetic acid for 45 seconds. Dactylogyrus was removed from channel catfish with a treatment of 1:4,000 of formalin for 1 hour. Channel catfish infected with Saprolegnia received a 1 ppm. flush treatment of malachite green. (Auth. abst.)

1541. Tompkins, W. A., and Colton Bridges. 1958. THE USE OF COPPER SULFATE TO INCREASE FYKE-NET CATCHES. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 16-20.

Copper sulfate was used in four Massachusetts ponds (21 to 52 acres) to promote accelerated fish movements and increase summer fyke-net catches. Application of the chemical at rates between 0.01 and 0.4 ppm. resulted in greatly increased harvests within 24 hours. All native species of fish reacted to the chemical. Costs are low enough to justify its use in fishery management and research where any problem necessitates the capture of large numbers of fish in a relatively short time. (Auth. abst.)

1542. Shelton, J. M. 1958. STOCK THOSE LAKES BY AIR. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 21-26.

About 200,000 sockeye salmon were stocked in 790-acre Spirit Lake and 50,000 were stocked in 250-acre Fort Lake. Approximately 2.5 tons of fish and 24 tons of water were loaded, transported, and dropped from an Air Force C-46 type aircraft. Estimated total mortality was less than 1 percent. Methods and equipment used are described.

1543. Threinen, C. W. 1958. CAUSE OF MORTALITY OF A MIDSUMMER PLANT OF RAIN-

BOW TROUT IN A SOUTHERN WISCONSIN LAKE, WITH NOTES ON ACCLIMATION AND LETHAL TEMPERATURES. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 27-32.

Hatchery-reared rainbow trout planted during August in a southern Wisconsin lake died soon after planting although water temperatures were not above the lethal temperature for the species. To determine the cause of death, three series of trials were set up. In the first series, the trout were transferred directly from the hauling truck to the lake and released under a variety of circumstances. A second series was given a short acclimation period, and the third series a 24-hour acclimation period. The results unquestionably pointed to heat death as the cause of this mortality, because there was good survival when the trout were tempered over a 24-hour period, and there was good survival among trout lowered to the cooler water of the thermocline. It is concluded that trout should not be planted without prolonged acclimation when the temperature of the receiving water is over 70° F or 20° higher than the holding water. (Auth. abst.)

1544. Craddock, Donovan R. 1958. CONSTRUCTION OF A TWO-WAY WEIR FOR THE ENUMERATION OF SALMON MIGRANTS. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 33.

Design and construction details of a weir which successfully provided a two-way count of adult and fingerling blueback salmon are described. No difficulties, mortalities, or delays were noted in passing adults upstream during the 2 years it has been in operation. Downstream trapping mortalities were insignificant. It was completed in 10 days by 4 men working under adverse conditions of cold and snow, and cost about $3,000 including labor and material. It can be operated by one man under ordinary circumstances. It is not, however, adaptable to all stream beds; requires considerable heavy equipment, e.g., bulldozer, jackhammer, welder, acetylene equipment; and the downstream traps can not be adjusted to compensate for very high water.

1545. Louder, D. E. 1958. ESCAPE OF FISH OVER SPILLWAYS. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 38-41.

Wire nets were installed on lake spillways in such a manner as to strain the water passing over the spillway. There was a considerable loss of fish, but the loss occurred during a very limited period. A heavy loss occurred during March and April. The loss appeared to be more readily correlated with season than with depth of overflow. In a 13-month period, a 160-acre lake lost approximately 10,000 fish, most of which were adults. All species of fish occurring in numbers in the lake studied were involved in the loss. (W. M. Lewis)

1546. Muench, Bruce. 1958. QUINALDINE, A NEW ANESTHETIC FOR FISH. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 42-44.

It was determined that quinaldine (2 methylquinoline) possessed desired qualities as an anesthetic for fish. The species of fish tested were: green sunfish, white crappie, yellow bullhead, golden shiner, and goldfish. These fishes were effectively anesthetized in concentrations of 5-12 ppm. Recovery time for anesthetized fish transferred to fresh water was from 1 to 10 minutes. Fish showed no acute toxic symptoms when exposed to low concentrations of quinaldine over relatively long periods of time. A solution of quinaldine maintained its anesthetic qualities for 6 days in the laboratory. The effectiveness at 50° to 54° F. was about the same as at 74° to 79° F. A longer recovery time was required for fish anesthetized at lower temperatures. (Auth. abst.)

1547. Turner, William R. 1958. THE EFFECTS OF ACID MINE POLLUTION ON THE FISH POPULATION OF GOOSE CREEK, CLAY COUNTY, KENTUCKY. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 45.

This study consisted of estimating the standing fish population by electrical shocker in two similar areas, one above and the other below the source of pollution. The total poundage of fish in the unpolluted area was nearly 12 times greater than in the polluted area. In the unpolluted area, game fish were slightly more than 7 times more numerous and pan fish almost 8 times more numerous than in the polluted area. Using a creel census obtained value of $1.22 per catchable-sized game fish and a commercial sale price of 20.6 cents on rough fish, the minimum estimated loss resulting from pollution of Goose Creek was $13,325.

1548. Mullan, J. W. 1958. A RECORD OF SOME APPARENTLY NATURAL AND DRASTIC CHANGES IN THE FISH POPULATION COMPLEX OF A LARGE MASSACHUSETTS POND. The Progressive Fish-Culturist, Vol. 20, No. 1, pp. 47-48.

Cataclysmic changes in the introduced and native fish population complex of a 127-acre, landlocked Massachusetts pond are documented by observations and netting records from 1911 through 1955, when the fish population was poisoned and recovered. One yellow perch, seven brown bullhead, no smallmouth bass, and no smelt, Osmerus mordax, were found in the 6 tons of fish recovered; whereas these species were common to abundant prior to the 1950's. Causation could not knowingly be attributed to defined factors. (Auth. abst.)

1549. Sowards, Charles L. 1958. SODIUM FLUORECEIN AND THE TOXICITY OF PRONOXFISH. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 20.

Sodium fluorecein is often used to mark waters during treatment with fish toxicants. Its effect on the toxicity of Pronoxfish was tested on small longnose dace. They exhibited no altered reaction; discomfort, distress, and death times being almost identical with dye and toxicant combined or toxicant alone. Furthermore, the dye alone had no harmful effects on the dace, for 6 appeared healthy after living in a brilliant green solution for 5 days.

1550. Snieszko, S. F. 1958. DRUGS TESTED FOR CONTROL OF KIDNEY DISEASE. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 26.

Effectiveness of 34 chemotherapeutic agents on different strains of kidney disease bacterium have been tested in vitro. Gantrisin proved far superior to all others. However, subsequent use of Gantrisin gave only temporary control.

1551. Holton, George D. 1958. SMALL-MESH GILL NETS USED IN WYOMING STUDIES, 1958. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 32.

Small-mesh nets obtained from Japan measuring 100 feet by 6 feet and having four 25-foot sections of 3/8, 1/2, 5/8, and 3/4-inch square mesh, were used in a mountain lake survey. They proved valuable in assessing reproduction of trout in these lakes taking fish down to 3.4 inches long. They also have been used to periodically check the growth of fingerling plants.

1552. Anon. 1958. OBSERVATIONS MADE FROM AN UNDERWATER PLASTIC CAGE. The Progressive Fish-Culturist, Vol. 20, No. 1, p. 48.

A plastic cage with platform permitting a biologist to observe fishing operations while in progress has been developed by the Bureau of Commercial Fisheries. Underwater visibility in Hawaiian waters with this equipment extends to a depth of 150 feet and possibly further in a horizontal plane. Behavior of anchovy and tilapia when used to chum tuna was observed. It was found that contrary to popular belief anchovy first swim away from the ship, returning to it if tuna are present. Tilapia, however, remained close to the vessel at all times. On the basis of this observation anchovy would have better "attractive" qualities than and thus seem superior to tilapia.

1553. Woodhead, P. M. J. 1957. REACTIONS OF SALMONID LARVAE TO LIGHT. The Journal of Experimental Biology, Vol. 34, No. 3, pp. 402-416.

The larvae of the brown trout, rainbow trout, and salmon were periodically active and negatively phototactic when illuminated. All three species exhibited a positive photo-orthokinesis, the duration of their activity being directly proportional to the log of the light intensity, over a limited range. The light threshold for the kinesis was about 0.005 m.c. but tended to be higher in many young larvae and lower in larvae of a later stage. An upper limit, although more variable, was demonstrated in some individuals, and lay between about 10 and 100 m.c. in the older larvae. It is suggested that a photo-orthokinesis, coupled with a negative phototaxis, serves well to maintain the larvae within the limits of their normal habitat at this stage of development.

No adaptation of the kinesis occurred after periods of up to 90 min. illumination. But larvae did exhibit a rhythm of activity, reaching peaks at intervals of about 15 min. An increase in the general level of activity, at all light intensities, occurred as the larvae grew, until they were finally active throughout an observation period. At this point the behaviour of the young fish changed, in particular the negative phototaxis was lost and the fish soon began to feed. The increase in the level of activity may be regarded as an index of development in trout and was shown to be related to the general growth of the embryo.

Rainbow trout ova hatch about a week earlier than brown trout at 10° C. This does not necessarily indicate a more rapid development in the rainbow trout, since the latter takes a week longer to achieve full activity, both species reaching this stage at about sixty days after fertilization. The behaviour of the salmon larva does not seem to be strictly comparable with that of the trout during the later stages of development. (Auth. summ.)

1554. Chapman, Douglas G. 1958. PROBLEMS OF ESTIMATION OF WILDLIFE MORTALITY RATES. Biometrics, Vol. 13, No. 4, pp. 548-549. (Presented at the meeting of the Biometric Society at Stanford University, August 27 and 28, 1957.)

The estimation of mortality rates of wild animals in general has been based on one of two methods--recoveries of tagged or marked members of the population and sampling of the population to determine its age structure at one or more time periods. The sources of bias in these methods are discussed. Several different formulae are reviewed and a new formula given which may be useful for those fish and animals where the largest cause of mortality is predation by man. The effect of the various sources of bias on the formulae is noted. Consideration is also given to the determination of estimates of the variances of the estimates; it will be usually preferable to find internal rather than external estimates of such variances.

1555. Gulland, John. 1957. SAMPLING PROBLEMS AND METHODS IN FISHERIES RESEARCH. FAO Fisheries Bulletin, Vol. X, No. 4, pp. 157-181.

A simple introduction to the principles of tackling sampling problems as they arise in fish population studies, particularly with regard to the catches of commercial vessels, and their size and age compositions. Some other problems likely to be met in fisheries biological studies are touched on, but the principles discussed are generally applicable.

A manual containing details of the statistical procedures with worked examples for the use of biologists concerned with sampling problems is now in preparation.

1556. von Brandt, A. 1957. NET MATERIALS OF SYNTHETIC FIBERS. FAO Fisheries Bulletin, Vol. X, No. 4, pp. 182-210.

There are at present seven groups of truly synthetic fibers used for net materials. Today only the groups of polyamide and polyvinyl alcohol fibers are of high value to fishermen. The groups of polyester fibers and copolymer fibers may be of

general interest in the future. Yet, at the present moment, only two fibers have a world wide importance for fishermen: Nylon/Perlon and, in some areas, Manryo/Kuralon.

Qualities of importance to fish nets are: resistance to rotting, resistance to sunlight, thermic quality, resistance to chemicals, specific gravity, resistance to water, resistance to fouling, breaking strength, knots extensibility and elasticity, flexibility, visibility, and resistance to abrasion.

Not much is known yet about these qualities, even for the small number of synthetic fibers used at present for nets by fishermen.

The main difficulty is that the qualities of net twines of synthetic fibers vary not only because of the differences between the different fibers due to manufacture, but even more because of the diverse processing procedures in spinning, twisting and plaiting. On the other hand, apart from the different requirements of fishermen, the qualities of the net materials can vary with every fishing gear and every fishing method. It cannot be said that this or that is the best synthetic fiber for net-making. Only the best man-made fiber for a special gear under specific conditions in a specific area can be determined.

In many cases, the worth of a new fiber for fishing can only be found by experiments with fishing gear. Comparative fishing alone can demonstrate whether the efficiency and the rentability of a new fiber is higher, on the whole, than those of the ones used before. Some qualities of twine can be controlled in laboratories. But there are other factors to be considered for all gear made of new materials, namely: quantity of the catches made, durability, and convenience of handling.

These qualities can only be determined by fishing experiments with gear made of new fibers. (From auth. summ.)

1557. Miller, Arthur R. 1958. THE EFFECTS OF WINDS ON WATER LEVELS ON THE NEW ENGLAND COAST. Limnology and Oceanography, Vol. III, No. 1, pp. 1-14.

Tidal records from Nantucket Sound, Cape Cod; Montauk, Long Island; and Portland, Maine, have been studied along with wind and barometric observations from each location. Results of this study show that departures from mean sea level due to wind may be resolved into two components. The first is a component which refers to symmetrical sinusoidal variation of sea level departure as a function of wind direction and applies to the outer coast and to the general level of Nantucket Sound in particular.

The second is an asymmetrical component which refers the responses of sea level at each observing station to local wind force, direction, fetch length, and local topography. Under different circumstances these components vary in relative importance in determining the local departure from mean sea level. In addition to wind direction and velocity, duration and size of wind field may determine whether one component is more important than the other.

The varying importance of each component probably governs the time-lag between peak winds and maximum sea level departures which will vary from several hours to as much as twenty hours. (Auth. abst.)

1558. Davis, Charles C. 1958. AN APPROACH TO SOME PROBLEMS OF SECONDARY PRODUCTION IN THE WESTERN LAKE ERIE REGION. Limnology and Oceanography, Vol. 3, No. 1, pp. 15-28.

It has been suggested by Pennak (1955) that tripton, rather than phytoplankton, is the main food of zooplankters in lakes. This concept is based upon his findings that the zooplankton biomass regularly exceeds the phytoplankton biomass, but that the mass of the tripton is greater than that of the zooplankton. In the present study samples of water were gathered from western Lake Erie and from several ponds. These were analyzed for dissolved organic matter, dissolved inorganic matter, volume of phytoplankton, volume of zooplankton, volume of μ-cells (mostly bacteria), and volume of organic and inorganic tripton. The phytoplankton biomass exceeded that of the zooplankton in nearly all samples. The average phytoplankton volume was 4.08 times greater than the average zooplankton volume. Furthermore, the phytoplankton volume usually was greater than that of the organic tripton, the ratio of the average volumes being 2.43 to 1. The reported results support the traditional concept that the zooplankton consumes primarily the phytoplankton. Consideration also is given of the bearing upon this problem of the dynamics of phytoplankton production and of grazing by zooplankters. (Auth. abst.)

1559. Collier, Albert. 1958. SOME BIOCHEMICAL ASPECTS OF RED TIDES AND RELATED OCEANOGRAPHIC PROBLEMS. Limnology and Oceanography, Vol. 3, No. 1, pp. 33-39.

"Red Tides" are blooms of plankton organisms which may or may not be lethal to aquatic organisms. The sudden increase in multiplication rates of the organisms is caused by a complex of biological factors; and physical factors play a major role in effecting mechanical concentration.

This paper deals with the biological factors operative in the genesis of blooms. Nutritional studies show that organic factors which occur naturally in the water are important. The existence of biologically active organic compounds and possible modes of action are discussed. The method of measurement of "carbohydrates" is explained and their production by bacteria-free cultures of Prorocentrum is demonstrated. Such organic compounds could serve as substrates for vitamin B_{12}-producing bacteria and thus play a role in the conditioning of water for succeeding populations.

Gymnodinium breve the causative organism of the Florida Red Tide, responds differentially to Gulf of Mexico waters of different origins. A suggested explanation is the interaction between environmental copper and hydrogen sulfide. Once

started, a bloom may replenish the required nutrients by the decomposition of the fish that it kills. (Auth. abst.)

1560. Anderson, G. C. 1958. SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON. Limnology and Oceanography, Vol. 3, No. 1, pp. 51-68.

The limnology of two highly saline lakes in Washington was studied in relation to the physical and chemical conditions which influence the growth and distribution of phytoplankton. The lakes were sampled at frequent intervals for a period of more than a year in 1950 and 1951. Morphometric conditions were determined, and routine sampling included measurements of temperature, transparency, oxygen, pH, alkalinity, phosphate, chlorophyll, and quantitative samples of phytoplankton. Lake Lenore, the less saline of the two (T. D. S. 14 g/liter), is shallow and was unstratified during the investigation. Dissolved nutrients were high and showed erratic variations during the summer. The phytoplankton population was taxonomically simple and was made up mainly of two species of diatoms--Amphora sp. which formed the spring bloom, and Chaetoceros elmorei which made up the late summer bloom. Soap Lake is relatively deep, meromictic, and saline (T. D. S. 35 g/liter). Temperature conditions were dichothermic, and the nutrient content was high, especially in the monimolimnion. A winter maximum and a summer minimum was observed in the phytoplankton population, and a change in the biota has been noted during dilution of the lake in recent years. Indication of grazing by zooplankton was found in both lakes.

1561. Kutkuhn, Joseph H. 1958. NOTES ON THE PRECISION OF NUMERICAL AND VOLUMETRIC PLANKTON ESTIMATES FROM SMALL-SAMPLE CONCENTRATES. Limnology and Oceanography, Vol. 3, No. 1, pp. 69-83.

Standard enumeration and volumetric determination techniques were employed to measure littoral plankton in a shallow prairie lake. Numerical and volumetric estimates were obtained from two-liter water samples which had their plankton (and tripton) content concentrated by means of a continuous-flow centrifuge.

Microplankton were enumerated, and their volumes were calculated on a species and total basis employing a two-stage sampling scheme. Distributions of various species in Sedgwick-Rafter cell mounts from four representative samples (containing at least 73 species) were examined. Occurrences of certain forms in the "fields" of Sedgwick-Rafter cell mounts conformed very closely to the Poisson series while others departed significantly. A majority of the latter were adequately fitted by the negative binomial distribution. For illustrative purposes, totals of selected species distributed as Poisson and negative binomial were estimated and assigned confidence limits. The value of the contagion or over-dispersion factor, $1/\hat{k}$, in constructing confidence limits was pointed out. In addition, the sample size required to yield an estimate having a specified precision was computed for a selected species distributed as Poisson. It was generally concluded that the error of estimated individual species totals usually greatly exceeds the desired level. Hence the size of subsample necessary to secure reasonably precise estimates for the numbers of each microplankton species in a given sample concentrate would be, as a rule, quite unwieldy.

Total microplankton counts per subsample were assumed to be normally distributed. Applications of standard statistical techniques indicated that efficiency in the two-stage sampling scheme is most effectively increased by including counts from additional primary sampling units (Sedgwick-Rafter cell mounts). The most practical subsampling ratio from the standpoint of increasing the precision of over-all numerical estimates without expending additional time and labor appeared to be four cell mounts and ten micrometer "fields" per mount.

Microplankton volumetric determinations were made employing a "calculated" volume method. The precision of volumetric unit counts for individual species were indeterminable because of the unknown distribution of the volumetric units. A lack of knowledge concerning such contagious distributions precludes a rigorous assessment of the "calculated" volume's utility.

Macroplankton were counted and had their volume calculated in a manner similar to that described for the microplankton except that the elementary sampling unit constituted an entire Sedgwick-Rafter cell mount. Very adequate numerical and volumetric estimates of individual macroplankton species and total macroplankton were secured from counts and measurements in only three cell mounts per sample concentrate. It was determined that had the allowable error of estimate been relaxed to 20 per cent (±) of the true value, on the average, a sample size of only one cell mount would have sufficed for estimating total macroplankton. (Auth. abst.)

1562. Hepher, B. 1958. ON THE DYNAMICS OF PHOSPHORUS ADDED TO FISHPONDS IN ISRAEL. Limnology and Oceanography, Vol. 3, No. 1, pp. 84-100.

The fate of phosphate added to fishponds and the inorganic processes of phosphorus fixation were studied in Israel. Conditions in these ponds are different from those of the more humid climatic zones in having alkaline water and high calcium content. In these conditions most of the phosphorus added is precipitated as $Ca_3(PO_4)_2$. The quantitative theoretical aspects of this are discussed. Another factor in the phosphorus fixation is the bottom mud. This fixation in the alkaline conditions prevailing is believed to be partly due to anion exchange reaction of the colloids and partly to reaction with calcium carbonate and not with heavy metals. The fixation of phosphorus to the mud is affected by the composition of the mud, becoming greater when the content of calcium carbonate and total colloids is higher. Fixation of phosphorus is lower with the accumulation of organic matter in the mud because of the low phos-

phorus adsorption capacity of organic colloids. Phosphorus fixation is higher when the mud is mixed with the water of the pond. In the fish-pond this is done by the carp in its search for food in the bottom mud. (Auth. abst.)

1563. Ellis, Robert J., and Howard Gowing. 1957. RELATIONSHIP BETWEEN FOOD SUPPLY AND CONDITION OF WILD BROWN TROUT, SALMO TRUTTA LINNAEUS, IN A MICHIGAN STREAM. Limnology and Oceanography, Vol. 2, No. 4, pp. 299-308.

Field study revealed great differences in the biological productivity of two adjacent areas of a Michigan trout stream resulting from the entrance of domestic sewage into the stream between the two areas. Monthly samples were collected from the two areas to determine the seasonal cycles in abundance of bottom fauna, feeding habits of the trout, and coefficient of condition of the brown trout. In the less productive area upstream, a paucity of food of aquatic origin caused a sharp decline in condition of the fish, a reduction in the quantity of food per stomach, and a shift to a diet containing a considerable portion of terrestrial organisms. In the more productive area downstream (which, throughout the year, had a greater volume of bottom fauna than the unproductive area) trout maintained a significantly higher and much less variable coefficient of condition, their stomachs contained more food in midsummer and did not show the increase in terrestrial foods. (Auth. abst.)

1564. Verduin, Jacob. 1957. DAYTIME VARIATIONS IN PHYTOPLANKTON PHOTOSYNTHESIS. Limnology and Oceanography, Vol. 2, No. 4, pp. 333-336.

A study of CO_2-removal during July and August, 1954, under natural conditions in western Lake Erie demonstrated a maximal rate during the hours of 0700-1000 (10 μmoles CO_2 absorbed per liter of water per hour), a reduced rate during the hours 1000-1600 (6μmol/L/hr), a slightly negative rate during the daylight hours 1600-1900 (-1 μmol/L/hr), and night-time negative rates similar to the daytime positive rates (-6μmol/L/hr). (Auth. abst.)

1565. Smayda, Theodore J. 1957. PHYTOPLANKTON STUDIES IN LOWER NARRAGANSETT BAY. Limnology and Oceanography, Vol. 2, No. 4, pp. 342-359.

A total of 82 surface samples were collected at three stations in lower Narragansett Bay from June 1954 through February 1955. Measurements of temperature, salinity, transparency, phosphate, iron, and oxygen were made, and 75 production and nutrient metabolism experiments were conducted.

Maximum phytoplankton populations were encountered in September and January, the mean standing crop being considerably in excess of that recorded in adjacent areas. Two hurricanes evoked a vigorous response in the phtoplankton. Skeletonema costatum accounted for 81.2 per cent ot the total population. Subsidence of the late winter flowering coincided with minimal phosphate concentrations. The development of the September maximum may reflect a decreased grazing rate. The role of stability and the degree of enclosure in the development of phytoplankton populations in protected areas are discussed.

An "atypical" phosphate cycle was encountered in which a summer maximum and a winter minimum occurred. It is postulated that the periods of phytoplankton activity with their accompanying rates of assimilation and regeneration govern this. Three fractions of iron were characterized by marked variations in concentrations.

A mean phosphate assimilation rate of 0.087 μg-at./L/day was obtained; regeneration rates were consistently negative. Iron assimilation had to be expressed as trends. On the average, diatoms increased by 53 per cent per day in the light bottle but decreased by 1.2 per cent per day in the dark one. The effect of this on measurements of respiration and gross production were discussed. Average rates of gross production and respiration were 0.43 and 0.32 ml O_2/L/day, respectively. The annual surface production was calculated to be 84 g C/M^3 whereas it was 64 g C/m^3 during the period of investigation. (Auth. abst.)

1566. Weiss, Charles M., and James L. Botts. 1957. THE RESPONSE OF SOME FRESHWATER FISH TO ISOPROPYL METHYLPHOSPHONOFLUORIDATE (SARIN) IN WATER. Limnology and Oceanography, Vol. 2, No. 4, pp. 363-370.

The toxic response and behavior of the fathead minnow (Pimephales promelas), the green sunfish (Lepomis cyanellus), and the goldfish (Carassius auratus) have been determined on exposure to water solutions of isopropyl methylphosphonofluoridate (Sarin). Comparison of the time of response over a wide range of concentrations and at several temperatures for the three species indicates changing rates of reaction to the toxic material. Analysis of the dose-response curves shows that the product of concentration and time of response is not equal to a constant. It is suggested that the point of maximum curvature of the dose-response curve, when plotted on arithmetic paper, be used as a value which would be most consistent for comparing relative toxicities of toxic agents or relative resistance of various species to the same toxic material. (Auth. abst.)

1567. Marvin, Kenneth T. 1957. A DEVICE FOR RAPID CONVERSION OF TITRATION VALUES TO SALINITY. Limnology and Oceanography, Vol. 2, No. 4, pp. 371-374.

Conversion of titration units to salinity units using the Knudson table is slow and tedious when many data are being processed. A study of the salinity equation resulted in various graphical solutions. A graph, which is presented, is probably the simplest of those derived, requiring only slight modification to convert it into a device that can be used to convert titration units into salinity units with a precision and speed far exceeding that obtained by using the Knudsen conversion tables. (Auth. abst.)

1568. Yasutake, W. T., and E. M. Wood. 1957.

SOME MYXOSPORIDIA FOUND IN PACIFIC NORTHWEST SALMONIDS. The Journal of Parasitology, Vol. 43, No. 6. pp. 633-641.

Three new myxosporidian species observed in samples of hatchery and wild salmonids collected in the Pacific Northwest are described and illustrated. The new species under consideration are: Myxidium minteri, found in the renal tubules, Chloromyxum majori in the glomerular capsule, and Myxobolus kisutchi in the spinal cord. (Auth. summ.)

1569. Miller, G. C., and J. H. Bennett. 1957. DIGENETIC TREMATODES IN LOUISIANA FRESHWATER FISHES. The Journal of Parasitology, Vol. 43, No. 5, Sect. 2, p. 36.

The parasitic fauna in Louisiana freshwater fishes is practically unknown. This fact has presented a number of interesting research problems. Present attempts are being made to present a rather comprehensive treatment of the biology and ecology of the parasites in Louisiana fishes. This report deals exclusively with the digenetic trematodes. In total, 629 fishes representing 14 families, 20 genera, and 30 species have been collected and examined. Most, but not all, were game fishes which were collected from 26 localities throughout the state. Nineteen species of digenetic trematodes, representing 11 families and 17 genera have been identified and studied. One of these is apparently a new species belonging to the genus, Phyllodistomum (Gorgoderidae). Studies on the 19 species have revealed new information regarding their morphology, taxonomy, ecology, and distribution. Sixteen of the 19 species studied are recorded as new to Louisiana. The digenetic trematodes were the most commonly encountered parasites in Louisiana freshwater fishes. This included both the number of species and the number of individuals. Of the 629 fishes examined, 386 or 61.3% were infected with some species of digenetic trematode. (Auth. abst.)

1570. Sindermann, Carl J. 1957. STUDIES ON THE PATHOGENICITY OF ICHTHYOSPORIDIUM HOFERI, FUNGUS PARASITE OF FISHES. The Journal of Parasitology, Vol. 43, No. 5, Sect. 2, p. 43.

Ichthyosporidium hoferi, a cosmopolitan fungus pathogen of marine and freshwater fishes, has been responsible for 5 recorded epidemics among marine fish populations, especially the sea herring, of the western North Atlantic, during the past 60 years. The most recent outbreak occurred from 1954 to 1956 in the Gulf of Saint Lawrence, where extensive mortalities of herring resulted (Leim, 1955, Fish. Res. Bd. Can., Prog. Rept. Atl. Sta. No. 62: 30-32; Sindermann, 1956, Maine Dept. Sea and Shore Fish., Res. Bull. No. 25: 1-23). While this outbreak was in progress in the Gulf of Saint Lawrence, the disease was at a low endemic level in the herring stocks of the Gulf of Maine, furnishing an admirable opportunity to study the disease in contrasting phases. Utilizing immature herring from the Gulf of Maine and goldfish from commercial sources as experimental animals, it was found that the virulence of the disease organism from both gulfs was similar. Culture growth rate and other characteristics were identical. Death of experimental herring due to acute infections resulted 20-40 days following initial massive exposure to fungus spores. Subacute infections, characterized by pronounced host cellular reaction, resulted from smaller dosages of spores. Results of these experiments can be related to observations of the disease outbreak in herring of the Gulf of Saint Lawrence, and indicate that (1) severity of infections increases with increasing infection pressure, and (2) resistance and individual variation in resistance of fish may be important in explaining the periodic changes in incidence that characterize this disease. (Auth. abst.)

1571. Ingram, William Marcus. 1957. HANDBOOK OF SELECTED BIOLOGICAL REFERENCES ON WATER POLLUTION CONTROL, SEWAGE TREATMENT, WATER TREATMENT. Public Health Service's Bibliograph Series No. 8, Publication No. 214, U. S. Dept. of Health, Education, and Welfare.

This is a revision of the handbook of the same title published in 1953. It is organized under the four main headings (i) selected biological references on water treatment, (ii) selected biological references on sewage treatment, (iii) selected biological references on water pollution control, and (iv) selected references on organism identification.

1572. Martin, Alex C., Ray C. Erickson, and John H. Steenis. 1957. IMPROVING DUCK MARSHES BY WEED CONTROL. Fish and Wildlife Service Circular 19-revised.

Though prepared by wildlife biologists for wildlife biologists, much of the information presented should have general application in fishery management work. General suggestions and methods are discussed. Twenty-one marsh and woody weeds, each with botanical, importance, and control discussions, are covered.

1573. Hassler, William W. 1958. THE FECUNDITY, SEX RATIO, AND MATURITY OF THE SAUGER, STIZOSTEDION CANADENSE CANADENSE (SMITH) IN NORRIS RESERVOIR, TENNESSEE. Journal of the Tennessee Academy of Science, Vol. XXXIII, No. 1, pp. 32-38.

The fecundity of Norris Reservoir sauger was estimated over a range of total length extending from 11.3 to 19.0 inches, or from a weight of seven ounces to 2.75 pounds. The approximate number of eggs produced per pound of body weight was calculated to be: $Y = 32,000X - 3,000$. (Y = total number of eggs produced and X = weight of sauger in pounds.)

Male and female sauger were considered equally abundant for the first two years of life. After this age the females were found to be more abundant. Both sexes of sauger generally attain maturity at age two in Norris Reservoir. The respective lengths at which more than 50 percent of male and

female sauger attain maturation were 13.0 and 13.5 inches respectively. The mathematical relationship between ovarian weight and body weight of ripe female sauger was calculated to be: $Y = 31.63 - .02855X + .00014665X^2$. (Y = ovarian weight in grams; X = body weight in grams.) (Auth. summ.)

1574. Hulse, David C., and Lawrence F. Miller. 1958. HARVESTING OF LARGEMOUTH BASS ON WHEELER RESERVOIR, ALABAMA, 1952-1956. Journal of the Tennessee Academy of Science, Vol. 33, No. 1, pp. 78-83.

The recapture of 12.4 percent of the largemouth bass tagged on Wheeler between 1952 and 1956 indicates that this species may undergo greater exploitation by angling than crappies and other pan fish. Largemouth bass showed the same harvest variability from year to year as found on several TVA storage reservoirs. But in general, the harvest percentage runs higher on storage reservoirs. In Wheeler Reservoir, harvest ranged from 5.7 to 15.2 percent a year.

All tagged fish were recaptured either the same year they were tagged or the year following. Of 595 tagged, 74 have been returned; all but 9 were recovered the same year as tagged.

Largemouth bass tend to move less extensively in mainstream reservoirs than in storage reservoirs, probably because water levels fluctuate much less. From point of tagging to point of recapture, they averaged 2.7 miles. The average time at large was 68.2 days, ranging from 23 to 77.9 days. There was no significant difference in average upstream and downstream travel, 4.1 and 4.2 miles. Similar data for Norris Reservoir show largemouth bass travelling an average of 4 miles, smallmouth bass 1.2 miles.

There is no evidence that year-round fishing has adversely affected the annual crop of largemouth bass on TVA mainstream or storage reservoirs.

1575. Brown, Jerram L. 1957. A KEY TO THE SPECIES AND SUBSPECIES OF THE CYPRINODONT GENUS FUNDULUS IN THE UNITED STATES AND CANADA EAST OF THE CONTINENTAL DIVIDE. Journal of the Washington Academy of Sciences, Vol. 47, No. 3, pp. 69-77.

Of the 33 currently recognized species and subspecies, 26 occur in the area covered by this key. Of the other 7, 2 have been collected only in the Mexican state of Yucatan, 2 are insular species found in Bermuda and the north coast of Cuba, and the remaining 3 are allopatric on the Pacific Coast.

1576. Mayne, John W. 1957. ROLE OF STATISTICS IN SCIENTIFIC RESEARCH. The Scientific Monthly, Vol. 84, No. 1, pp. 26-33.

Variation in experimental results is typical of almost all branches of science, and because of this variation, the problem of drawing conclusions from scientific experiments is a problem in induction. The contribution of statistical techniques to the induction problem and other phases of scientific methods is discussed in general terms. Probability, testing of hypotheses, estimation, and the design of experiments are described briefly. It is pointed out that the statistical theories of estimation and testing of hypotheses provide solutions to the problem of induction in the form of definite statements that have a known and controllable probability of being correct and that in analyzing the results of experiments the function of statistics is to measure the certainty of conclusions and to assure the scientist that only valid generalizations and inferences are made. However, in order to do so, it is necessary that experiments be set up and conducted in accordance with the principles of experimental design. The advantages of using the minimum number of essential observations and of exercising care in the collection of data are emphasized. (Auth. summ.)

1577. Schoffman, Robert J. 1958. AGE AND RATE OF GROWTH OF THE YELLOW BASS IN REELFOOT LAKE, TENNESSEE FOR 1955 AND 1957. Journal of the Tennessee Academy of Science, Vol. 33, No. 1, pp. 101-105.

The 1955 Tennessee Legislature abolished commercial fishing in Reelfoot Lake for game fish except for yellow bass. Prior to that time, commercial fishing for all game fish was legal. This study will serve as an aid in future studies of game fish to determine what effect protection will have on the rate of growth of game fish. Data for 518 yellow bass caught commercially on trot lines in 1955 and the 511 caught similarly in 1957 are presented. No fish over 6 years old, longer than 12 inches, or heavier than 11 ounces were taken. Increase in length is slow after the second year of life while increase in weight is greater in the older age groups.

Age Group	No. of Fish	1955 Average Length Inches	Average Weight Ounces
2	127	7.72	3.58
3	167	8.69	5.25
4	204	9.47	7.17
5	20	10.71	10.40
		1957	
2	68	7.20	3.66
3	236	8.44	5.39
4	177	9.50	7.67
5	30	10.66	10.73

1578. Fields, Paul E. 1957. GUIDING MIGRANT SALMON. The Scientific Monthly, Vol. 85, No. 1, pp. 10-21.

Following introductory remarks concerned with the magnitude of the problem of guiding salmon and the methods now being employed, this article reports observations and results of studies conducted at the Fish Behavior Laboratory at the University of Washington on the reaction of downstream migrants to light.

Each of the experimental studies summarized represents a partial step in obtaining control of the movements of downstream migrant salmon and steelhead trout. Light barriers have been emphasized

because they have been found to be more consistently effective than any other type of stimulus investigated. Under certain conditions they seem to work for all sizes and varieties of Pacific salmon and trout. They appear to be less expensive to install and operate in larger areas than other types of guiding devices, and the light stimulus is not likely to produce detrimental after effects related to the size of the fish or the intensity of the light.

These guiding results have not been validated in a large river under conditions of high velocity and turbidity, nor in the deep impoundments above the high dams. Observations at relatively low velocity indicate that the effectiveness of a light barrier is lost in extremely turbid water. The only stimulus normally encountered in the environment which has seemed to have a greater effect on the behavior of salmon than light is velocity. At present, no method has been found for combining these two stimuli in an effective guiding installation without placing gear under the surface of the water where it would be subject to damage from floods.

Many basic problems remain to be solved. The fundamental nature of the response of salmon to light has not been clarified because of the lack of replicated observations. The nature of light source, wave length, intensity of illumination (both above water and at the level of the fish's eye), adaptation of the retina as determined by latitude and weather data, diurnal and seasonal cycles, type of light movement (if any), the species, size, and physiological condition of the fish (true migrant as opposed to resident fish which have been displaced downstream by freshets), and water temperature, velocity, turbulence, and turbidity are only a few of the factors which may influence the reaction of the salmon.

1579. Miller, Robert Rush. 1957. UTILIZATION OF X-RAYS AS A TOOL IN SYSTEMATIC ZOOLOGY. Systematic Zoology, Vol. 6, No. 1, pp. 29-40.

This paper covers the different types of radiation, hard and soft rays, the value as well as limitations of the techniques, the machines available for this type of use, and the exposure and processing of the film. In ichthyology and fishery research, this method makes possible the study of vertebral variation through the analysis of long series of specimens at taxonomic levels from race to family.

1580. Keleher, J. J., and B. Kooyman. 1957. SUPPLEMENT TO HINKS' "THE FISHES OF MANITOBA". Department of Mines and Natural Resources, Province of Manitoba, FRB 481, pp. 103-117.

In the 14 years since "The Fishes of Manitoba" was published, there have been changes in the scientific and common names of some fishes. In addition, knowledge concerning the biology of many Manitoba fishes has been considerably clarified. In order to note these advancements, especially in nomenclature and distribution, a supplement, concerned only with freshwater fishes, has been prepared for use with the original text. References to subsequent Manitoba studies in fishery biology are included.

1581. Harris, Eugene K. 1957. FURTHER RESULTS IN THE STATISTICAL ANALYSIS OF STREAM SAMPLING. Ecology, Vol. 38, No. 3, pp. 463-468.

A formula is proposed for computing the variance (or standard deviation) of the number of species observed in independent sets of k' samples, based on data supplied by a study series of $n > k'$ samples. An example of the necessary calculations is included. This formula is applied to observations of macro-invertebrate bottom fauna in six areas of a midwestern stream. The same data have been used earlier to illustrate a procedure for estimating the mean number of species in k' samples.

Results using the proposed formula are compared with those given by a laborious empirical method which involves counting the number of species found in many different sets of k' samples. Agreement between the two methods is generally good, but the former seems to reflect a more general picture of species distribution in the area. Use of these results to determine the number of samples for future surveys is discussed. The importance of drawing a large number of carefully selected study samples is emphasized. (Auth. summ.)

1582. Griffith, Ruth E. 1957. A PORTABLE APPARATUS FOR COLLECTING HORIZONTAL PLANKTON SAMPLES. Ecology, Vol. 38, No. 3, pp. 538-540.

A portable apparatus for collecting horizontal plankton samples and operational technique in using it to collect oyster larvae is described. The unit consists of a small gasoline-powered portable pump mounted on a skiff and a pivoted intake pipe that can take samples to a depth of 12 feet at a speed of three to four miles per hour. This apparatus can be adapted not only for collecting representative plankters that swarm, but also for many other kinds of aquatic work. (Auth. summ.)

1583. Hart, J. S. 1957. SEASONAL CHANGES IN CO_2 SENSITIVITY AND BLOOD CIRCULATION IN CERTAIN FRESH-WATER FISHES. Canadian Journal of Zoology, Vol. 35, No. 2, pp. 195-200.

The asphyxiation level of oxygen at various levels of CO_2 (CO_2 sensitivity), measured on the brown bullhead, southern channel catfish, and largemouth bass decreased as the water warmed up with the approach of summer conditions in Florida. In the same general period blood pressure of the bass and channel catfish fell with seasonal change from winter to summer temperatures. Correlated changes were found in the weight of the ventricle with occluded blood. In the channel catfish, ventricle weights were lowest when water temperatures were warmest. They were greatest in winter in Florida and Tennessee fish when temperatures were lowest. Small seasonal trends in stroke output were also observed. (Auth. abst.)

1584. Houston, Arthur H. 1957. RESPONSES OF JUVENILE CHUM, PINK, AND COHO SALMON TO SHARP SEA-WATER GRADIENTS. Canadian Journal of Zoology, Vol. 35, No. 3, pp. 371-383.

The responses of chum, Oncorhynchus keta (Walbaum), and pink, O. gorbuscha (Walbaum), salmon fry, and coho, O. kisutch (Walbaum), salmon fry and smolts to sea water were studied in sharp-gradient tanks. Chum and pink fry responded positively to isotonic and hypertonic solutions of sea water, but coho fry only to the former. During parr-smolt transformation, coho responded positively to hypertonic sea water. Responses of chum fry acclimated to sea water for 24 hours prior to observation were comparable in intensity to those of unacclimated fry, but less rapid. Activity of acclimated fry decreased less rapidly than did that of unacclimated fry. Fresh water control experiments indicated the presence of some factor or factors which resulted in preferences for "recognized" areas. The effects of positive responses to increased salinity are discussed in relation to the migratory movement of these species from fresh water into the sea. (Auth. abst.)

1585. Irvine, D. G., Katherine Newman, and W. S. Hoar. 1957. EFFECTS OF DIETARY PHOSPHOLIPID AND CHOLESTEROL ON THE TEMPERATURE RESISTANCE OF GOLDFISH. Canadian Journal of Zoology, Vol. 35, No. 6, pp. 691-709.

The temperature resistance of goldfish is increased by additions of cholesterol or phospholipid to basic diets of pablum or pablum and pilchard oil. The relative effectiveness of these treatments varies with the season and with the duration of the feeding experiment. In low-temperature resistance tests, the cholesterol effect was most marked during the earlier period of chilling and the suggestion is that cholesterol increases the capacity of fish to resist cold narcosis - not death. In heat resistance tests, the phospholipid-fed fish showed a tendency toward heat narcosis which was not evident with cholesterol-fed animals. Increased temperature resistance was closely correlated with increased tissue cholesterol but only weakly correlated with the less modified tissue phospholipid. Although these diets also produced definite changes in total lipid content, moisture content, unsaturation of total lipids, and the cholesterol/phospholipid ratio, no evident correlation between these factors and temperature resistance of the goldfish was found. Data are discussed in relation to several theories of temperature death. (Auth. abst.)

1586. Ford, P., and J. D. Newstead. 1958. STUDIES ON THE DEVELOPMENT OF THE KIDNEY OF THE PACIFIC PINK SALMON, (ONCORHYNCHUS GORBUSCHA (WALBAUM)). I. THE DEVELOPMENT OF THE PRONEPHROS. Canadian Journal of Zoology, Vol. 36, No. 1, pp. 15-21.

The literature relating to pronephros development in fishes is discussed and the course of development in the pink salmon described. The vascularization of the kidney is described and the histological differentiation of the elements of the kidney listed with special respect to the epithelia of the tubules. The appearance of the myeloid tissue is noted. (Auth. abst.)

1587. Ford, Peter. STUDIES ON THE DEVELOPMENT OF THE KIDNEY OF THE PACIFIC PINK SALMON (ONCHORYNCHUS GORBUSCHA (WALBAUM)). II. VARIATION IN GLOMERULAR COUNT OF THE KIDNEY OF THE PACIFIC PINK SALMON. Canadian Journal of Zoology, Vol. 36, No. 1, pp. 45-47.

Counts of the glomeruli of pink salmon fry raised in fresh water were compared with those of fry raised in sea water. A significant increase in the count was observed in fry of the same fork length raised in fresh water. (Auth. abst.)

1588. Fisher, Kenneth C., and Charlotte M. Sullivan. THE EFFECT OF TEMPERATURE ON THE SPONTANEOUS ACTIVITY OF SPECKLED TROUT BEFORE AND AFTER VARIOUS LESIONS OF THE BRAIN. Canadian Journal of Zoology, Vol. 36, No. 1, pp. 49-63.

The frequency of spontaneous movements made by speckled trout (Salvelinus fontinalis) was determined at a number of different constant temperatures. The relation between the frequency and temperature was found to be complex, showing two maxima. One of these constantly occurred at approximately the temperature selected by normal trout in a horizontal temperature gradient and the other occurred two to three degrees below the upper lethal temperature.

The relation between frequency of movements and temperature was not affected by (1) destruction of the forebrain, (2) by section of the lateral line nerves, or (3) by destruction of both the forebrain and the dorsal part of the cerebellum. Destruction of only the dorsal part of the cerebellum profoundly changed the relation between frequency of movements and temperature: it caused the disappearance of the first peak.

Brief consideration was given to the legitimacy of relating the activity of animals in different constant levels of environmental factors with behavior in gradients of these factors. (Auth. abst.)

1589. Scott, W. B. 1957. DISTRIBUTIONAL RECORDS OF FISHES IN WESTERN CANADA. Copeia, No. 2, pp. 160-161.

Three cyprinids, previously unrecorded from Saskatchewan and one catostomid are listed. These are Hybognathus hankinsoni, Chrosomus eos, Pfrille neogaea, and Pantosteus jordani.

1590. Riggs, Carl D. 1957. MUGIL CEPHALUS IN OKLAHOMA AND NORTHERN TEXAS. Copeia, No. 2, pp. 158-159.

Three specimens, positively identified, have been taken from the river immediately below Denison Dam, Lake Texoma, and from the draft

tubes of the hydro-electric turbines. Another most likely record reported by a workmam at the dam was taken 2-3 years ago. The Denison Dam impounds the Red River, the boundary between much of Oklahoma and Texas, and is located in Bryan County, Oklahoma and Grayson County, Texas.

1591. Massmann, William H. 1957. NEW AND RECENT RECORDS FOR FISHES IN CHESAPEAKE BAY. Copeia, No. 2, pp. 156-157.

Cites 20 species observed or reported since publication of "Fishes of Chesapeake Bay" by Samuel F. Hildebrand and William G. Schroeder in 1928.

1592. John, Kenneth R. 1957. OBSERVATIONS ON THE BEHAVIOR OF BLIND AND BLINDED FISHES. Copeia, No. 2, pp. 123-132.

Anoptichthys were attracted to sounds made by an aeration nozzle bubbling in water. Anoptichthys and blinded Astyanax avoided contact with a flat glass barrier upon approaching it for the first time immediately after they had been transferred to a strange aquarium. They seldom collided with solid surfaces unless they were unduly excited or disturbed, but they frequently established contact with the surfaces. Anoptichthys commonly foraged over the vertical surfaces as though feeding. It was impossible to determine consistently with the unaided eye whether or not the fish established contact with an object, because they often executed avoidance maneuvers at very close range and while swimming rather rapidly.

Anoptichthys apparently does not "memorize" the position of solid surfaces, as was indicated by their common behavior toward familiar and strange surfaces and by their unhesitant manner of swimming through a site that had formerly contained a solid surface. It, and other blinded species, learned to avoid objects that they apparently could not detect except through direct contact. At first, Anoptichthys and blinded Astyanax repeatedly swam into surfaces composed of spaced pin points, but in fewer than 25 minutes, at the expense of less than 20 impacts, they learned to avoid the site. Having learned this, they continued to avoid it for at least half an hour after the object had been removed, having passed through the site occasionally during that interval. They were able to remember spatial relationships precisely. They commonly initiated avoidances of the pin points at distances of 6 to 8 inches and also frequently swam into the pin points while approaching slowly and hesitantly. This type of approach suggested that the fish were able to remember their approximate spatial position. After removing the pin-studded object, the fish persisted in executing avoidances of the site at distances as great as 6 to 8 inches and commonly executed the avoidance after they had passed part way across the site formerly occupied by the points. These observations indicate that the fish would commonly collide with solid surfaces if they depended on their memory of spatial relationships rather than on their perception of mechanical cues received at a distance, and showed also, that the fish never succeed in avoiding pressure-transparent objects persistently. (Auth. summ.)

1593. Lagler, Karl F., and Charles Steinmetz. 1957. CHARACTERISTICS AND FERTILITY OF EXPERIMENTALLY PRODUCED SUNFISH HYBRIDS, LEPOMIS GIBBOSUS X L. MACROCHIRUS. Copeia, No. 4, pp. 290-292.

Hybrid young from this cross were stocked along with largemouth bass in newly constructed Lake Naomi near Mundelein, Illinois, in 1949 and 1950. A 15-foot dam barred upstream entry of fish and the lake was filled entirely by surface run-off. The F_1 hybrids of this cross proved to be interfertile.

Most of the characters of the F_1 hybrids compared with those of the parent species were found to be intermediate. Those found to be non-intermediate were (i) number of dorsal spines, lower in F_1 than in either parental species; (ii) number of dorsal soft rays, a little higher than both parental species; and (iii) standard length/upper jaw length, lower in F_1 (and F_2) than for both parents.

On the basis of the apparent high degree of fertility of the F_1 of this cross, the hope of maintaining desired population balance in farm ponds by stocking hybrids is dimmed. Other crosses should be tried, however, before this use of hybrids is discarded.

1594. Ward, J. W. 1957. THE REPRODUCTION AND EARLY DEVELOPMENT OF THE SEA CATFISH, GALEICHTHYS FELIS, IN THE BILOXI (MISSISSIPPI) BAY. Copeia, No. 4, pp. 295-298.

In the Biloxi Bay region of Mississippi during 1952 through 1956 the spawning season of G. felis extended from the first week in May until the first week in August. The males were sexually functional from the first of March until the first of July. Histological structure of the ovaries indicated that oogenesis began in early March and reached the peak of maturity the first part of June.

Eggs from the body cavity were artificially fertilized with the sperm of a macerated testis. These developed through the 2, 4, 8, 16, blastula, and gastrula stages, which covered a period of 29 hours. Embryos from 5 to 45 mm. in length are described.

1595. Warburton, Barbara, Clark Hubbs, and Donald W. Hagen. 1957, REPRODUCTIVE BEHAVIOR OF GAMBUSIA HETEROCHIR. Copeia, No. 4, pp. 299-300.

It has been theorized that the pronounced notch in each pectoral fin of G. heterochir is used to steady the gonopodium during copulation. This use has now been observed repeatedly. Reproductive behavior is described in detail.

1596. Pew, Patricia. 1957. OCCURRENCE OF YOUNG DOLPHIN, CORYPHAENA HIPPURUS, IN A TEXAS BAY. Copeia, No. 4, p. 300.

During the summers of 1954, 1955, and 1956 nine young dolphin were captured in the Rockport, Texas, boat basin. The nearest pass to the Gulf of Mexico is Aransas Pass, approximately 15 miles from the site of capture. Summer water temperatures range from 71° to 90° F. All were highly colored, mottled red, orange, and gold.

1597. Ebeling, Alfred W. 1957. THE DENTITION OF EASTERN PACIFIC MULLETS, WITH SPECIAL REFERENCE TO ADAPTATION AND TAXONOMY. Copeia, No. 3, pp. 173-185.

The Mugilinae in the eastern Pacific comprise 3 genera, 2 species groups, and 7 or 8 species. This comparative study of the tooth morphology, development, and adaptation has disclosed valuable interspecific differences. Teeth have been found to be of particular value in the identification of the juvenile or querimana stages. A dichotomous key to the genera and species of Mugilinae, based on dentition, is presented.

1598. Gibbs, Robert H., Jr. 1957. CYPRINID FISHES OF THE SUBGENUS CYPRINELLA OF NOTROPIS. I. SYSTEMATIC STATUS OF THE SUBGENUS CYPRINELLA, WITH A KEY TO THE SPECIES EXCLUSIVE OF THE LUTRENSIS-ORNATUS COMPLEX. Copeia, No. 3, pp. 185-195.

This paper redefines the subgenus Cyprinella, shows in a broad sense the interspecific relationships, and provides a key for the identification of the species exclusive of the lutrensis-ornatus complex.

1599. Turner, C. L. 1957. THE BREEDING CYCLE OF THE SOUTH AMERICAN FISH, JENYNSIA LINEATA, IN THE NORTHERN HEMISPHERE, Copeia, No. 3, pp. 195-203.

Specimens of Jenynsia lineata which breed in the spring and summer in Argentina become adapted easily to a permanent spring and summer breeding season in the northern hemisphere. Specimens shifted from the southern to the northern hemisphere in September during their breeding season will finish a normal breeding cycle if they are kept on Argentina day length. If the same specimens are shifted to northern hemisphere day length in March they will produce a second cluster of broods in May, June and July.

Young specimens born in the fall and early winter on normal northern hemisphere day length and continued on northern hemisphere day length mature early and produce broods in June, July and August. Substitution of room temperature for the extremes of temperature in the natural habitat is partially responsible for early maturity of the fall and winter young but increasing day length is the principal controlling factor.

The beginning of brood production within two to three months can be induced in mature animals by substituting increasing for declining day length provided a previous period of declining day length is two months or more in length. Cessation of brood production is induced usually within two months by the substitution of declining for increasing day length.

Inherent reproductive features are: response to day length and temperature, brood size, interval in time between broods and number of broods per breeding season. Experimentally induced departures from reproductive features occurring in the normal habitat indicate considerable capacity for plastic responses which could enable the species to survive climatic changes, other factors being equal. (Auth. summ.)

1600. Lockley, Arthur S. 1957. ADRENAL CORTICAL HORMONES AND OSMOTIC STRESS IN THREE SPECIES OF FISHES. Copeia, No. 3, pp. 241-242.

From this limited study it appears that ACTH and Adrenal Cortex Extract have no significant influence on the tolerance limits to osmotic change in the strictly marine Gobiesox maeandricus, the marine estuarine Leptocottus armatus armatus, and a freshwater fish, Carassius auratus.

The ACTH was administered in concentrations of 1/10, 1/100, 1/1000, 1/10,000 each in 1/10 cc amounts to four separate groups of each species, 5 fish to a group. Controls were fish injected with 1/10 cc of isotonic saline as well as non-injected fish. Adrenal Cortex Extract was given in concentrations of 1 dog unit, 1/10, 1/100, 1/1000 dog units in the same manner. Goldfish were given ACTH in one dosage only (1/10 mgm in 1/10 cc) and Adrenal Cortex Extract in one dosage only (1/10 dog unit in 1/10 cc.). Salinity and time of exposure were fresh water-7 hours; 3.3%-1 day; 7.5%-8 days; 16.6%-2 days; 25.5%-2 days. Goldfish were kept at salinities of 7.5% and 16.6% for 2 and 1 day respectively.

1601. Mather, Frank J., and Robert H. Gibbs. 1957. DISTRIBUTIONAL RECORDS OF FISHES FROM WATERS OFF NEW ENGLAND AND THE MIDDLE ATLANTIC STATES. Copeia, No. 3, pp. 242-244.

Data recorded concern either species which are new to or have seldom been recorded from certain areas, or distributional information which has bearing upon the life histories of species. Those cited are Hypoprion signatus, Elops saurus, Sphyraena borealis, Katsuwonus pelamis, Thunnus albacares, Thunnus alalunga, Auxis thazard, Sarda sarda, Scomberomorous cavella, Caranx crysos, Caranx hippos, Rachycentron canadus, Decapterus punctatus, Selar crumenophthalmus, Alectis crinitus, Lutianus analis, Mullus auratus, and Otophidium welshi.

1602. Sawyer, Philip J. 1957. LABORATORY CARE AND FEEDING OF LARVAL LAMPREYS. Copeia, No. 3, p. 244.

Larval lampreys were maintained for several months in square, galvanized tubs of about 15-gallon capacity, lined with black asphaltum, and arranged on a sloping table in such a manner that a lip of each overlapped that of the next lower one.

About four inches of washed fairly coarse sand was placed in each tub. Dechlorinated water was allowed to flow through the tubs only in daylight hours, to prevent night time migration losses. They were fed plankton from cultured "green water".

1603. Leary, Terrance R. 1957. THE BONEFISH, ALBULA VULPES, IN TEXAS. Copeia, No. 3, pp. 248-249.

A specimen of the bonefish, believed to be the third Texas specimen, was taken in a trawl at 21 fathoms, ESE of Port Aransas, Texas. The second Texas specimen, apparently unreported, was taken by trawl at 19 fathoms 45 miles south of Port Aransas.

1604. Fitzgerald, J. W. 1957. RANGE EXTENSION FOR THE WESTERN MUDMINNOW, NOVUMBRA HUBBSI. Copeia, No. 3, p. 248.

Two specimens of this species were taken in the Deschutes River at Olympia, Washington. This is the first record of this species for this river, and as far as is known, is the second watershed in which Novumbra has been found. Heretofore the species has been obtained only from the Chehalis River watershed, specifically from the Satsop River and from the Humptulips River.

1605. Reed, Roger J. 1957. THE PROLONGED SPAWNING OF THE ROSYFACE SHINER, NOTROPIS RUBELLUS (AGASSIZ), IN NORTHWESTERN PENNSYLVANIA. Copeia, No. 3, p. 250.

Observations made over a three-week period in French Creek and Slippery Rock Creek, indicate that this species has a five-week spawning period in northwestern Pennsylvania. In 1954, spawning activities were observed on May 26 and again on June 10, 18, and 25. Observations made in 1955 correspond to those of 1954. In 1956 the extremely cool spring apparently caused a delay in spawning until June 1; the season finished July 3.

1606. Medcof, J. C. 1957. NUPTIAL OR PRENUPTIAL BEHAVIOUR OF THE SHAD, ALOSA SAPIDISSIMA (WILSON). Copeia, No. 3, pp. 252-253.

A peculiar behaviour pattern of shad was observed from the bridge across the Southwest Margaree River, Nova Scotia, at Scotsville, at three o'clock in the afternoon of June 21, 1935. The day was sunny and water clarity excellent.

A school of 25 shad composed entirely of uniform size adult shad, when first sighted, was swimming upstream in single file. Close to the bridge they began a counter-clockwise circling (6-8 feet in diameter) which continued for 1.5 minutes. Speed increased gradually and the diameter of the circle decreased until the arched bodies of the fish were whirling at a startling rate in a path no more than 2.5 feet in diameter. Bodily contact was evident, displacing but not dislodging scales. When the speed reached what seemed incredible, the leader flashed off, headed upriver, and again began circling slowly in mid-stream. The others followed in single file and went through the described pattern. In 10 minutes, this same behaviour was observed six times. No cloudiness of the water could be observed to indicate that the fish were spawning.

1607. Hubbs, Clark. 1958. FERTILITY OF F_1 HYBRIDS BETWEEN THE PERCID FISHES, ETHEOSTOMA SPECTABILE AND E. LEPIDUM. Copeia, No. 1, pp. 57-58.

As males of this hybrid combination are sterile, all F_1 crosses were made with females of E. spectabile. Hatching percentages of eggs were slightly lower than those of controls. Percentages to develop through larval stages were also somewhat lower than the controls. Similar to F_1 hybrids, viability of offspring does not appear to be correlated with degree of allopatry. Lowered viability of the ova from hybrids may be significant; however, laboratory held fish often produce eggs with reduced viability and wild caught fish seldom do. A dietary deficiency of Vitamin A or a precursor has been shown to be the cause. Eggs from the hybrid stocks have also been successfully crossed with sperm of Etheostoma radiosum, Hadropterus scierus, and Percina caprodes. Similar to back crosses, those out crosses have low viability when compared with their controls, probably for the same reason.

1608. Harrington, Robert W. 1958. MORPHOMETRY AND ECOLOGY OF SMALL TARPON, MAGALOPS ATLANTICA VALENCIENNES FROM TRANSITIONAL STAGE THROUGH ONSET OF SCALE FORMATION. Copeia, No. 1, pp. 1-10.

This graded series of 259 tarpon from 16.0 mm. to 59.6 mm. standard length was collected from salt marshes along the Indian River, Florida. Body proportions, the relation of weight to length, meristic counts and the smallest post-leptocephalus tarpon, and scale formation are discussed.

1609. Iversen, Edwin S., and Howard O. Yoshida. 1957. NOTES ON THE BIOLOGY OF THE WAHOO IN THE LINE ISLANDS. Pacific Science, Vol. XI, No. 4, pp. 370-379.

The availability of wahoo caught by trolling and longline fishing indicated the existence in the Line Islands of a small population that was most abundant in shallow water within a few miles of land. Males were relatively more abundant in catches from the more northerly islands than in those from the more southerly islands. Examination of wahoo gonads showed all stages of maturity present. The number of mature eggs in a single female was estimated at over six million. The wahoo taken close to the islands showed little variety in their diet as judged by stomach contents. Of the identifiable food material the main items were mackerel scad, skipjack, and squid.

An examination of size frequency distributions from the Line Islands area revealed that the females attain a larger size than the males, and there is some suggestion that the two sexes grow at different rates.

No attempt to estimate growth by modal progression is made since there are indications that the samples were not representative of a homogeneous population unit. A length-weight relationship for wahoo from the Line Islands is given by the equation:

Log weight (pounds) = -9.4199 + 3.50583 log length (millimeters).

The wahoo was found to be parasitized by trematodes, nematodes, and copepods. (Auth. summ.)

1610. Enami, Masashi. 1958. STUDIES IN NEUROSECRETION. XI. ACTIVITY OF AN EXTRACT FROM THE CAUDAL NEUROSECRETORY SYSTEM OF THE EEL AS TESTED UPON THE BUOYANCY OF TAILLESS AND FINLESS GOLDFISH. Proceedings of the Japan Academy, Vol. 34, No. 1, pp. 50-55.

After an initial unstationary phase of up and down movement lasting for hours or days, the fish eventually became settled at the bottom with the head directed downwards. Injections of an extract of isolated caudal tips of the spinal cords of the eel forced the tailless goldfish to float at the surface for several hours or even days in the characteristic head-down posture. Significant increase in buoyancy, measured with an apparatus run after the principle of cartesian diver manometry, took place within 30 minutes of injection, and was followed by another increase initiated towards the end of 180 minutes. Control injections of physiological saline or distilled water were wholly ineffective with respect to increase of buoyancy during the first four to five hours in which uniform responses were recorded for the extract injections.

Four eluates obtained by paper-chromatography of the extract were tested. First phase buoyancy was exhibited by one, second phase by another, and one eluate resulted in no increased buoyancy. Injection of zinc sulphate simulated reaction to the eluate producing first phase buoyancy while injection $NaHCO_3$ produced a reaction similar to the second phase producing eluate.

1611. Wright, P. G. 1958. AN ELECTRICAL RECEPTOR IN FISHES. Nature, Vol. 181, No. 4601, pp. 64-65.

Certain families of fishes, namely the Mormyridae of tropical Africa and the Gymnotidae of Central and South America, possess a small electric organ of intermittent activity. All these fishes are reported to react to electrical pulses and to conductivity changes caused by placing metal objects in their vicinity. It has been suggested that the impulses they produce form part of their sensory system.

Tests were run on the cranial nerves of Mormyrus kannume, close to its entry into the skull. Recording electrodes attached to this exposed and sectioned nerve indicated an action potential whenever electrical pulses were delivered to the fluid in which the fish were immersed. Though the results were necessarily incomplete, it is considered that they indicate that a receptor system exists in this species, that this system is sensitive to electrical stimuli not delivered directly to it, and that the receptor system is localized to the region of the base of the dorsal fin.

1612. O'Rourke, Fergus J. 1958. AN INEXPENSIVE EASILY CONSTRUCTED FISH-MARKING TAG. Nature, Vol. 181, No. 4608, p. 577.

This tag consists of transparent vinyl plastic tubing, 1/8 inch inside diameter, cut in 2 inch lengths. One end is sealed by heat and pressure, and before sealing the other end, instructions and number are placed inside on paper. Monofilament nylon is threaded through a hole in one of the flattened sealed ends and through the back of the fish just anterior to the dorsal fin and then tied. Advantages over the hydrostatic tag devised by Einar Lee, which this one resembles, are that it is considerably less expensive and is less conspicuous when submerged.

1613. Pruginin, J., and N. Lipshitz. 1957. THE CONTROL OF NOXIOUS WEEDS IN FISH PONDS. Bamidgeh, Vol. 9, No. 3, pp. 50-61.

This article lists the plants commonly encountered, their degree of pond infestation, and regional distribution. Methods of control, including grazing, mowing or burning, and use of herbicides employed in soil sterilization, foliage treatment, and as a dilution in pond water, are covered. Control of broad-leaved annuals, Inula viscosa, Proposis farcata, Alhaji maurorum, and Myriophyllum spicatum has been obtained with 2,4-D; 2,4-D Esters have given control of Typha angustata, Scirpus litoralis, Cyperus sp.; 2,4,5-T has given control of Rubus sp., Conyza dioscoridis, Polygonum sp.; Sodium arsenite of Potamogeton nodosus, Ceratophyllum demersum; Dalapon of Phragmites communis, Typha angustata, Panicum repens, and most other grasses; and C. M. U. of Najas minor. Frequency of application and concentration which gave satisfactory results are discussed.

1614. Robins, C. Richard. 1957. THE ROGER FIRESTONE TARPON INVESTIGATION. Progress Report of the Marine Laboratory of the University of Miami, 57-14, pp. 1-6.

Spawning is believed to take place in Florida along the coast in bays and passes, the larval forms being swept into the lagoons and estuaries. Juvenile tarpon have been found far up freshwater drainage ditches, canals, rivers, and in ponds. The dates and places of spawning and the extent of spawning and nursery grounds are being investigated.

Based on scale analysis and other data, it is concluded that the size of tarpon year-classes do not decrease markedly until an age of 12-13 years, that fishes along the western coast grow faster than those on the east coast, that fish do not grow much

in length or weight after age 11 or 12, that very few fish over 11 years have been recorded, that the oldest fish studied to date was in age-class 16, and that restrictions in tournament competition eliminate the first 7, likely 8, year-classes on the east coast and the first 4, likely 5, year-classes on the west coast.

1615. Gray, James. 1957. HOW FISHES SWIM. Scientific American, Vol. 197, No. 2, pp. 48-54.

The efficiency of the propulsion system of a fish and the dolphin and whale are explored. Studies of small fish in tanks have led to the conclusions that (i) a typical fish can exert a very powerful initial thrust when starting from rest, producing an acceleration about four times greater than gravity; (ii) at times of stress it can exert for a limited period a sustained propulsive thrust equal to about one quarter or one-half the weight of its body; (iii) the resistance exerted by the water against the surface of the moving fish appears to be the same order as that exerted upon a flat, rigid plate of similar area and speed; (iv) the maximum effective power of a fish's muscles is equivalent to about .002 horsepower per pound of body weight.

The validity of certain of these conclusions becomes suspect, however, when the dolphin which has been timed better than 22 miles per hour, is considered. A six-foot dolphin traveling at 22 miles per hour with drag equivalent to that of a rigid plate of similar area would require 2.6 horsepower. This conclusion is fantastic; it is difficult to endow the dolphin with much more than .3 horsepower of effective output. If this is correct, flow must be virtually laminar, a conclusion which aerodynamic or hydrodynamic engineers consider altogether unlikely. Thus an impasse. One point worth re-examination is the reduction in drag and closer approximation to laminar flow which the oscillating movement of a swimming animal's tail may contribute through reduction in turbulence. Also the fish's body is not rigid. These speculative suggestions are offered to stimulate cooperative research by biologists and engineers.

1616. Newell, Arthur E. 1958. TROUT STREAM MANAGEMENT INVESTIGATIONS OF THE SWIFT RIVER WATERSHED IN ALBANY, NEW HAMPSHIRE. Survey Report No. 7, New Hampshire Fish and Game Department, 40 pgs.

Creel census during the four years of study showed a large increase in angling pressure and a progressively higher return of fish planted. An experimental reduction of 30 percent in the total number of fish stocked in 1956 resulted in a decrease in angling quality. It is believed that a 15 percent reduction in numbers stocked would have maintained desirable angling quality. Angling quality and harvest of stocked fish during the period of study compared favorably with other New England areas.

The rate of return of stocked fish increased from a low of 20 percent in 1952 to a high of 50 percent in 1956, indicating a vastly improved stocking schedule. A small harvest of wild fish and a lack of angling pressure in areas inhabited by wild fish indicated a lack of interest in fishing for small wild fish.

Tagging studies indicated a lack of movement in stocked fish when planted in water that exceeded 50° F. but a definite downstream movement when temperatures were lower.

Population estimates indicated a large population of wild brook trout in the main stream above Rocky Gorge and in the tributary streams, but age composition, growth rate, condition, survival, and size and age at maturity indicate a rather undesirable situation, especially under the old six-inch length limit restrictions.

The use of weirs to study the value of tributary streams to the main stream was largely unsuccessful due mainly to a combination of small fish and widely fluctuating water levels. Rotenone was successfully used, however, to show that fishes in the tributary streams apparently maintain separate and discrete populations and that tributary streams do not, necessarily, act as "breeder streams" if other suitable spawning areas are available.

Management recommendations concerned with areas, and size and species to be stocked, the methods and time of stocking, and size limits are presented. (Auth. summ.)

1617. Ellis, Robert W. 1957. CATCHES OF FISH BY CHARTER BOATS ON FLORIDA'S EAST COAST. Special Service Bulletin #14, The Marine Laboratory of the University of Miami, pp. 1-6

Catch records were obtained by interviews and from log book entries of charter boat captains and anglers. Records of 443 trips were obtained between February 1, 1956 and January 31, 1957.

The occurrence of the major species in the sample relative to each other and to the total catch of all species is believed to indicate the following features: (i) dolphin were taken on more trips than any other species, followed by bonito, kingfish, and barracuda, (ii) dolphin were taken in greatest numbers, followed by kingfish, bonito and grouper, (iii) amberjack accounted for the greatest catches by weight, followed by dolphin, kingfish, and sailfish, and (iv) marlin had the greatest average weight per fish, followed by sailfish, amberjack, and sharks.

Projection of sample data provides an estimate of 5,755,744 pounds and 703,749 fish composed of 19 species caught by charter boats. (From auth. summ.)

1618. Murdock, James F. 1957. REPORT ON THE SPORT AND COMMERCIAL FISHERIES OF THE BRADEN AND MANATEE RIVERS. Report of the Marine Laboratory of the University of Miami, 57-23, pp. 1-22.

This study was made to appraise the conflict in interests between commercial and sport fishermen. Field work was performed during the last three weeks of February, 1957.

In general there was little competition in the use of areas or spots by sports and commercial fishermen; commercial fishing is usually done at night and most sport fishing is done during the day or early evening. Both sport and commercial fishermen use the Upper Manatee and Braden Rivers more during the winter season and to some extent throughout the year.

Snook, redfish, black drum, sheepshead, bottomfish, and trout are caught in the Manatee River by both sport and commercial fishermen. Commercial landings of these species combined from the Manatee River probably represent less than 2 percent of the total commercial landings for Manatee County. Thirty species of fish were collected in the Manatee River area. The river is important for most of these fish as a spawning area. However, in general, the important sport and commercial fishes do not spawn in areas such as the Manatee River, but near passes in the Gulf. Rivers, bays, and adjacent lowlands are undoubtedly important nursery grounds for most of the fish found in this region.

Because competition between sport and commercial fishing is much less than supposed and damage to spawning and nursery areas by commercial gears is virtually non-existent, abolishment of commercial fishing in this area is not recommended. (From auth. summ.)

1619. Moffett, Alan, and John E. Randall. 1957. THE ROGER FIRESTONE TARPON INVESTIGATION. Progress Report of the Marine Laboratory of the University of Miami, 57-22, pp. 1-18.

A population of juvenile tarpon, located in a shallow brackish pond on Lower Matecumbe Key, Florida, measured 33 to 141 mm. in fork length; the smallest was not far removed from the post-larval state (believed to be a leptocephalus).

Experiments on temperature tolerance of juveniles from 71 to 130 mm. revealed an upper limit in sea water of about 40° C. The lowest temperature in which tarpon survived for 24 hours was about 19.5° C. initially. In experiments about two weeks later, the fish could tolerate temperatures lower than 17° C.; the increased tolerance to cold water is believed due to acclimitization in the laboratory. They were found to be able to withstand transfer from sea water to fresh water and back to sea water 24 hours later.

Stomach contents of 24 tarpon 70 to 189 mm. in fork length were examined. Those from 70 to 83 mm. fed almost exclusively on small copepods of the same genus Cyclops. Above this the plankton was supplanted by larger food items such as corixid insects and crab larvae, and ultimately by small fish.

Growth data for young tarpon, based on recovered tagged specimens, and for adult tarpon, based on scale examination, is presented. (From auth. summ.)

1620. Trefethen, Parker S., John W. Dudley, and Myron R. Smith. 1957. ULTRASONIC TRACER FOLLOWS TAGGED FISH. Electronics, Vol. 30, No. 4, pp. 156-160.

Development of automatic ultrasonic tracking and ranging equipment for the Fish and Wildlife Service provides a method for obtaining information on adult salmon behavior in relation to dams in the Northwest. The design and production of this new research tool was prompted by the need for obtaining a more detailed knowledge of individual salmon behavior than has been possible by conventional methods.

The equipment consists of a miniature ultrasonic source (sonic fish tag), a self-positioning directional transducer array with a receiver-servo system (auto-track) and an echo-ranging system.

In operation, the tracking system positions inself or homes on the sonic tag attached to a fish and aims the transducer in that direction. The range and bearing of the fish are displayed on a calibrated cathode-ray tube. The depth of the fish is calculated from the range and the angle at which the ultrasonic impulses from the equipment are projected into the water. By plotting the position of the fish and the position of the boat simultaneously, the operator is able to obtain detailed fish behavior patterns. (Auth. abst.)

1621. Snodgrass, James M., and John H. Cawley, Jr. 1957. BATHYTHERMOMETER TELEMETERS OCEAN DATA. Electronics, Vol. 30, No. 5, pp. 142-145.

A two-unit transistorized system lowered from ship gives plot of temperature against depth. Absolute accuracy in depth is better than $\pm$ 0.25 percent and temperature sensitivity of 0.05 degree C. can be obtained. Vibrating wire transducer and thermistor Wien-bridge oscillator provide depth and temperature data, respectively. (Auth. summ.)

1622. DeWitt, John W. 1957. MORTALITY OF AQUATIC INSECTS AND FISHES CAUSED BY USE OF LATEX TUBING IN EXPERIMENTAL APPARATUS. Science, Vol. 126, No. 3278, p. 840.

Mortality during numerous trials prompted the testing of individual parts of the apparatus for harmful effects. Subsequent tests showed that latex rubber tubing, apparently entirely suitable for most experimental purposes, should be used with caution in experiments involving the recirculation of water and where species of animals sensitive to the constituents of the tubing are utilized. Even though mortality might not result from such use of the tubing, the results of sensitive physiological tests might be markedly influenced. Plastic tubing is suggested as a substitute.

1623. Leivestad, H., H. Anderson, and P. F. Scholander. 1957. PHYSIOLOGICAL RESPONSE TO AIR EXPOSURE IN CODFISH. Science, Vol. 126, No. 3272, p. 505.

Unpublished experiments performed at Woods Hole, Mass., on dogfish (Squalus) prompted this study of codfish at the Biological Station at Drøbak, Norway. The heart rate of fish taken from water

dropped within a few seconds to half or less than half of normal, the lactic acid in muscles rose to a maximum during air exposure, and, in contrast, the blood lactic acid remained low during air exposure. When returned to water the pulse rate was rapidly restored, the lactic acid in muscles fell, and the blood lactic acid rose to a maximum after some 5 to 15 minutes and then returned to normal. These events are similar to those found when mammals and birds are submerged, and when fish are frightened. What benefit this is to codfish is an evolutionary puzzle.

1624. Burt, Wayne V., and John Queen. 1957. TIDAL OVERMIXING IN ESTUARIES. Science, Vol. 126, No. 3280, pp. 972-973.

One of the processes of eddy diffusion, labelled "tidal overmixing", that is due to tidal currents in Coos Bay and River estuary on the Oregon coast is discussed. The salt content of the Coos Estuary is nearly constant with depth everywhere and increases linearly from the fresh river water at the head of the estuary to full sea water at the mouth. Right after low water, the whole estuary is nearly vertically homegeneous, having the same salt content from the surface to the bottom in any given position. During flood tide, the surface water moves upstream more rapidly than the bottom water causing an unstable salinity and density inversion, with more salt, dense water on the surface than on the bottom. With the change of tide the heavier water sinks and the lighter water rises, causing complete mixing. During ebb, tide and river flow combine to give maximum velocities bringing about some turbulent vertical mixing during flow over the relatively shallow bottom. This tends to inhibit the formation of strong vertical stability, and plays an important role in concentration patterns of salt, pollutants, oxygen, plankton, nutrients, and silt.

1625. Castenholz, Richard William. 1958. SEASONAL CHANGES IN THE ALGAE OF FRESH-WATER AND SALINE LAKES IN THE LOWER GRAND COULEE, WASHINGTON. Dissertation Abstracts, Vol. XVIII, No. 1, p. 33.

A two-and-one-half year investigation of the series of natural fresh-water and saline lakes in the Lower Grand Coulee has provided a quantitative and qualitative record of many of the seasonal changes occurring in the non-planktonic algae. A comparison of the algal floras of the two classes of lakes has also been a prominent aspect of the work.

Quantitative estimates of the seasonal changes of attached algae were made through the use of glass plates (28 by 28 cm.) which were submerged for 2 or 4 weeks at different depths. Dry weight and organic weight (loss on ignition) of the attachment material on plates were determined and the amount or organic matter was expressed as a production rate. In most of the lakes the ash was composed almost entirely of diatom frustules. It was suspended uniformly in water, dried on a slide, and mounted in hyrax. Proportional counts of the different species were made. The expression of degree of dominance for each species was based on the product of the cell count and a calculated volume factor. Essentially, then, a production rate of total organic matter and for each important species was obtained.

The seasonal changes demonstrated by this method were striking. Fresh-water lakes (200-500 p.p.m. T.D.S) showed a bimodal production rate curve, with a large pulse in spring and a small pulse in fall. There were characteristic spring diatom species, some of which reappeared in the fall, and there were characteristic summer species which usually remained through fall. Characteristic spring dominants were Cymbella affinis, C. cistula, C. mexicana, Fragilaria vaucheriae, Gomphonema eriense, Synedra acus, and S. ulna. Characteristic summer species were Epithemia sorex, E. turgida, and Rhopalodia gibba. The summer period was also characterized by large amounts of filamentous green and blue-green algae, including Cladophora, Spirogyra, and Oscillatoria; these did not become attached to the glass plates.

In the saline lakes (8,000-25,000 p.p.m. T.D.S.) there was a pronounced diatom pulse in the fall and sometimes through the winter and spring as well. The dominant forms were Amphora spp. and Nitzschia spp. The saline lakes were conspicuous for their lack of seasonality.

Although regular analyses of environmental factors included only temperature, pH, and conductivity; there were, nevertheless, strong indications that temperature, together with light, had a very important influence on the development and maintenance of diatom pulses and on the seasonal succession of species in both classes of lakes.

About 240 species and varieties of algae were found in the fresh-water lakes as a group. The saline lakes had about 65. The overlap was considerable with 25 taxa being common to both types of lakes. Some "Grand Coulee" species of well known saline affinities are the diatoms Amphiprora paludosa, Amphora acutiuscula, A. coffeaeformis, Anomoeoneis polygramma, Campylodiscus clypeus, Chaetoceros elmorei, and Nitzschia epithemoides. The floras of the saline lakes of the Lower Grand Coulee were compared with other saline lakes of western North America (E.G., Saskatchewan, North Dakota). In general, it was found that many more species occurred in high salinities elsewhere. In most cases these lakes have a pH of 7-9 and are of the sodium or magnesium sulfate type. In the Lower Grand Coulee lakes the pH is very high (9.3-10.0); the chief cation is sodium; and carbonates, chlorides, and sulfates are almost equally important anions. Thus, the higher pH and the nature of the anions in the Lower Grand Coulee lakes may be related to the smaller list of species here. (Auth. abst.)

1626. Boyd, John Edward. 1958. THE USE OF DAPHNIA MAGNA IN THE MICROBIOASSAY OF INSECTICIDES. Dissertation Abstracts, Vol. XVIII, No. 1, p. 51.

The microcrustacean Daphnia magna was found to be suitable for the bioassay of a number of

organic insecticides, including DDT, methoxychlor, parathion, malathion, Diazinon, EPN, aldrin endrin, and heptachlor. The quantities of these compounds to which Daphnia give measurable response are between 0.1 and 350 parts per billion in aqueous medium. Chlorobenzilate, dieldrin, and lindane were less toxic to this organism, and further work will be required before Daphnia can be used to test for the presence of these compounds in micro amounts.

The various factors affecting the response of Daphnia to these toxic compounds were investigated in detail. A relatively simple synthetic medium was devised for rearing and testing. It contained potassium sulfate, sodium bicarbonate, and calcium chloride, dissolved in deionized distilled water. Daphnia were found to be sensitive to the pH and the ionic strength of the medium, the optimal pH being between 8.2 and 8.8, and the optimal ionic concentration 400 to 500 milligrams of electrolyte per liter.

It was found that the concentration of auxiliary solvent (acetone) in the test medium had a pronounced effect on the response of Daphnia to insecticides. Concentrations of acetone of 0.4 to 0.5 per cent caused an apparent reduction in the toxicity of certain insecticides, probably through a "protective stupefaction" effect. Acetone concentrations above 0.5 per cent were toxic to Daphnia.

The number of Daphnia present in a given volume of test medium influenced the level of response of the organisms to aldrin, but not to parathion or methoxychlor. This difference appeared to be directly related to the relative toxicities of the compounds themselves.

Most of the compounds tested were soluble in water to the extent of only a few parts per million, so that in some cases the solubility was seemingly the limiting factor; there was definite evidence that insecticide particles in suspension were not toxic to the organism. Two compounds, DDT and dieldrin, gave results which indicated that their solubilities limited their toxicity to Daphnia.
Several criteria have been used as measures of toxicity in bioassays, and these were investigated in some detail in the present study. It was concluded that dosage-response relationship was the most satisfactory for use with Daphnia. With the exception of DDT and dieldrin noted in the preceding paragraph, all dosage-response curves obtained in this investigation were linear over a relatively wide range of toxicant concentration.

On the basis of the studies reported here it was concluded that Daphnia magna can serve as a satisfactory test organism for the bioassay of micro amounts of insecticides, and thus supplement and extend the range of quantitative measurements of spray residues. (Auth. abst.)

1627. Randall, John Frank. 1958. THE DISTRIBUTION OF THE FISHES OF THE CATAWBA-WATEREE RIVER DRAINAGE BASIN, NORTH CAROLINA AND SOUTH CAROLINA. Dissertation Abstracts, Vol. XVIII, No. 1, p. 341.

This distributional study is limited to the Catawba-Wateree River Basin, a large upland tributary part of the Santee River System. Since the Catawba-Wateree River and the Congaree River unit to form the Santee River about one hundred miles from the Atlantic Ocean, this study will deal only with fresh-water, anadromous, and catadromous fishes. Furthermore, this work is limited to the brooks, creeks, and small rivers which flow into the Catawba-Wateree River proper.

The Catawba-Wateree River Basin encompasses parts of or, in some instances, all of eleven North Carolina and seven South Carolina counties. The entire basin has an area of approximately 5,875 square miles. This is about one third of the area of the Santee River System. The Catawba-Wateree River Basin has parts of three physiographic provinces within its boundaries: The Blue Ridge, the Piedmont Upland, and the Coastal Plain.

The method most often used for collecting specimens was seining. Approximately one and one-half hours were spent in seining an average of one-fourth of a mile of stream distance at each collecting site.

The collecting of specimens for this distributional study of the fishes of the Catawba-Wateree River Drainage Basin was undertaken July 16, 1954, and completed September 24, 1956. Specimens were obtained from two hundred-twenty-nine different locations.

This study shows that there are currently eighty-six species and subspecies of fishes inhabitating the waters of the Catawba-Wateree River Basin. These represent seven orders, nineteen families, and forty-seven genera.

There were fifty species and subspecies collected from the Coastal Plain, sixty-eight species and subspecies from the Piedmont Upland and thirty-one species and subspecies from the Blue Ridge.

Burton and Odom (1945) and Derrick (1955) have shown that the number of species per station decreases with altitudinal increases in certain streams of the higher mountains. Salvelinus fontinalis (Mitchill) is the only species found in the small brooks of the extreme headwaters of the Catawba-Wateree River. At a slightly lower elevation Salmo gairdnerii irideus Gibbon is found and a little below this the number of species increases rapidly.

There is no increase in the number of species per station as lower elevations are reached in the Piedmont Upland and Coastal Plain Provinces of the Catawba-Wateree River Basin. The Piedmont Upland Province contains more species than the Coastal Plain Province and the Coastal Plain Province contains more species than the Blue Ridge Province of the Catawba-Wateree River Basin. All species found in both the Blue Ridge and the Coastal Plain are also found in the Piedmont Upland, i. e., there is no case of discontinuous distribution when all three physiographic provinces are considered together.

Thirty-seven species have not previously been reported in the scientific literature as inhabitants of the Catawba-Wateree River Basin. Eight species have not previously been reported in the scientific

literature as inhabitants of the Santee River System. Two fish have previously been reported from the Catawba-Wateree River Basin but were not collected during this survey. (From auth. abst.)

1628. Cole, Charles Franklyn. 1958. THE TAXONOMY OF THE PERCID FISHES OF THE GENUS ETHEOSTOMA, SUBGENUS BOLEOSOMA, OF EASTERN UNITED STATES. Dissertation Abstracts, Vol. XVIII, No. 3, p. 1155.

A systematic study of the boleosomid fishes (Percidae) of the eastern United States was undertaken. Three species complexes within the subgenus Boleosoma are recognized east of the Appalachians. The olmstedi group is composed of Etheostoma o. olmstedi; E. o. atromaculatum; E. o. vexillare; and E. o. new subspecies plus Etheostoma perlongum. The nigrum complex is composed of Etheostoma n. nigrum; E. n. eulepis; and E. n. susanae west of the Appalachians and E. n. maculaticeps and three new subspecies from the James, the Roanoke and the Tar-Neuse River Basins east of the Appalachians. The E. longimanum-E. podostemone group is the third species complex. Three additional species, E. jessiae; E. chlorosomum; and E. stigmaeum, from the Mississippi valley and Gulf Coast drainages are also included in the subgenus Boleosoma, as presently understood, but were not treated in this study. (From auth. abst.)

1629. Shellhamer, Robert Howard. 1958. HISTOCHEMICAL STUDIES OF THE LAMPREY Dissertation Abstracts, Vol. XVIII, No. 3, p. 1165.

Many studies on the morphology, development, metamorphosis, and physiology of lampreys (Class-Cyclostomata, Subclass-Petromyzontidae) have been reported since the early general description of the morphology of the lamprey was published by Rathke in 1826. In 1856 A. Muller gave the first scientific notice that Ammocoetes branchialis is the larval form of the lamprey and since that time the history, ecology, and economics have been intensively investigated. Little can be found in literature in the field on the chemical constitution of lampreys. It was the purpose of this study to describe the histochemistry of the lamprey in the various stages of the life cycle, that is, to superimpose a chemical picture on the histological structure of embryo, larval (ammocoete), and adult lamprey. Methods, materials, and findings are presented in detail. (From auth. abst.)

1630. Donaldson, Lauren R., and George H. Allen. 1958. RETURN OF SILVER SALMON, ONCORHYNCHUS KISUTCH (WALBAUM) TO POINT OF RELEASE. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 13-22.

Silver salmon, Oncorhynchus kisutch (Walbaum), of the 1950 brood year were reared at the Soos Creek Hatchery, State of Washington Department of Fisheries, until January 19, 1952. On that date, approximately 72,000 fingerlings were divided between the State of Washington salmon hatchery on Issaquah Creek and the ponds of the School of Fisheries, University of Washington. After two months of orientation, the two lots of fish were released to migrate to sea on March 18 and 19, 1952.

The movement of the fish in the sea was followed by noting the return of the marked fish to the sport and commercial fisheries.

Adult salmon returning during the winter of 1953-1954 were examined for marks. None of the marked fish returned to Soos Creek, their native stream. Those fish released at the School of Fisheries returned up the ladder to the rearing ponds and those released at Issaquah migrated to the watershed, returning to the area of release. (Auth. abst.)

1631. Shields, James T. 1958. EXPERIMENTAL CONTROL OF CARP REPRODUCTION THROUGH WATER DRAWDOWNS IN FORT RANDALL, SOUTH DAKOTA. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 23-33.

Water drawdowns of 1 1/2 to 2 feet were effected at Fort Randall Reservoir immediately following periods of major carp spawning in 1955, 1956, and 1957. Eggs thus exposed were killed. Predictions of the time of spawning were based on gonadal conditions of mature fish, water temperature and weather forecasts. Major spawning occurred in shallow (less than 1 foot deep) flats during periods of warm, calm weather when open-water temperature first reached 62-68° F. Effectiveness of the drawdowns in limiting carp reproduction was judged by the size of the age class produced each year in comparison to a previous year and to other species sampled by the same methods of spot-poisoning, shoreline seining, gill netting and frame netting. Size of the age class of carp established each year was relatively small. It is concluded that the planned drawdowns were primarily responsible for poor reproduction. (Auth. abst.)

1632. Carlander, Kenneth D. 1958. DISTURBANCE OF THE PREDATOR-PREY BALANCE AS A MANAGEMENT TECHNIQUE. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 34-38.

Disturbance of the predator-prey relationship may result in increased angler success and may sometimes provide an effective management tool. Exceptional harvest of walleyes (Stizostedion vitreum) in Clear Lake, Iowa, in 1951 is perhaps explained by reproductive failure of yellow perch (Perca flavescens) in 1950 and by elimination of young yellow bass (Morone interrupta) through more than normal predation. Stocking of 5 northern pike (Esox lucius) per acre in the fall of 1953 increased the weight of the predator population by about 10 percent. In the first 6 weeks of the next fishing season, over 20 percent of the stocked northerns were caught by anglers. (Auth. abst.)

1633. Henderson, Croswell, and Quentin H. Pickering. 1958. TOXICITY OF ORGANIC PHOSPHORUS INSECTICIDES TO FISH. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 39-51.

Bioassays were made on ten organic phosphorus compounds, which are now in use or proposed for use as insecticides, to determine their comparative toxicity to fish. There was a wide range in toxicity of the different compounds with 96 hour TL_m (median tolerance limit) values ranging from 0.20 to 121 p.p.m. No relationship was apparent between toxicity and chemical structure. With one exception dilution waters with different characteristics (pH, alkalinity, and hardness) apparently had little or no effect on toxicity. Bluegills were somewhat more sensitive to several of these compounds than fathead minnows. The organic phosphorus compounds were less toxic to fish than many of the chlorinated hydrocarbon insecticides. No definite correlation could be established in the toxicity of organic phosphorus compounds between fish, insects and mammals. (Auth. abst.)

1634. Olson, Donald E. 1958. STATISTICS OF A WALLEYE SPORT FISHERY IN A MINNESOTA LAKE. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 52-72.

Data on walleye (Stizostedion v. vitreum) population dynamics and angling statistics from a northwestern Minnesota Lake are presented. Many Point Lake has an area of 1,716 acres, and in years studied (1955-1957) had an average annual fishing pressure of 17 man-hours per acre. The average annual harvest of fish of all species was 7.5 pounds per acre of which about 60 percent was walleyes and pike (Esox lucius). To study relationships between the walleye population and catch, 3,249 adult walleye were marked with distinguishing fin clips during the three years, and these fish tallied in anglers' catches. By application of appropriate statistics it is concluded that, on the average, 26.8 percent of the adult walleye population was taken by anglers each year. Loss of adult fish from natural causes was found to be about 4 percent per year.

Walleye of age-group III averaged 8.4 ounces in weight, but during the next four years the fish increased in weight at an average rate of 7.6 ounces per year, the accelerated average growth of the older fish largely reflecting rapid weight increase of female fish. The angling harvest was 3,402 walleyes weighing 4,826 pounds in 1955, 4,973 fish weighing 6,292 pounds in 1956, and 3,730 walleyes weighing 4,215 pounds in 1957. During the years studied, recruitment exceeded loss from total mortality and the population of walleyes, three and more years old, increased from an estimated 11,546 in 1955, to 14,675 in 1956, and 18,220 in 1957.

Application of population and catch data to a mathematical model indicates that, with present growth and natural mortality rates, a higher sustained yield in pounds could be had at lower fishing intensity. This would allow a yield of fewer fish but of larger average size. It is pointed out, however, that an attempt to create a larger sustained yield in pounds at a lower fishing intensity might not be realized because of compensatory changes in growth and natural mortality. (Auth. abst.)

1635. Beeton, Alfred M. 1958. RELATIONSHIP BETWEEN SECCHI DISC READINGS AND LIGHT PENETRATION IN LAKE HURON. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 73-79.

Fifty-seven paired photometer and Secchi disc measurements made at 18 stations in Saginaw Bay and Lake Huron support the view that a counter-clockwise current usually occurs in the Bay with more transparent Lake Huron water flowing in along the northwest shore and less transparent Bay water flowing out along the southeast shore. The average percentage transmission of surface light intensity, at the Secchi disc depth, was 14.7 percent. Discrepancies in the relationship of disc readings to percentage transmission of surface light are related to the condition of the sky and sea. It is suggested that these discrepancies can best be explained on the basis of the spectral sensitivity of the human eye and its response to surface glare. (Auth. abst.)

1636. Kutkuhn, Joseph H. 1958. UTILIZATION OF PLANKTON BY JUVENILE GIZZARD SHAD IN A SHALLOW PRAIRIE LAKE. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 80-103.

Irruptions of gizzard shad, Dorosoma cepedianum (LeSueur), in North Twin Lake, Iowa in 1954 and 1955 provided opportunities for investigating certain basic ecological relationships of this species. Of the approximately 358 plankton species and varieties found in North Twin Lake, 260 were encountered in shad digestive tracts. On a volume basis, phytoplankton (primarily Cyanophyta and Chlorophyta) constituted the bulk of young-of-the-year and yearling gizzard shad food. Crustacean zooplankton were important food elements of recently hatched individuals.

Rotifers and crustaceans were about equally abundant in the plankton and in gizzard shad digestive tracts, and a fair degree of relationship was found between the amounts of green algae and diatoms ingested by age 0 shad and the proportions of the same forms in the plankton. Yearling gizzard shad apparently select green algae. Blue-green algae were apparently not consumed in proportion to their relative abundance in the environment. Where the relatively scarce Microcystis aeruginosa appeared to be a selected item, the most abundant plankter, Aphanocapsa delicatissima, constituted comparatively small portions of gizzard shad foregut contents. Gizzard shad are capable of consuming relatively minute plankters, some commonly ingested forms being no larger than 20 microns in greatest dimension.

Circumstantial evidence suggests that large shad populations may play a significant role in suppressing

irruptions of objectionable algae. Where hatching periods overlap, feeding activities of newly hatched shad may adversely affect survival of the young game species through direct competition for crustacean plankton which both groups seem to require during early growth stages. (Auth. abst.)

1637. Sykes, James E. 1958. A METHOD OF DETERMINING THE SEX OF THE STRIPED BASS, ROCCUS SAXATILIS (WALBAUM). Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 104-107.

A method is described for sexing striped bass Roccus saxatilis (Walbaum) by use of a serrated-jaw ear forceps. The instrument is used to extract gonads from dead fish in samples of commercial catches, without incurring damage to the fish which affects the market quality. The gonads are examined later in the laboratory and are identified as male or female. The technique has proven satisfactory in large scale sampling of commercial catches. (Auth. abst.)

1638. Grice, Frank. 1958. EFFECT OF REMOVAL OF PANFISH AND TRASHFISH BY FYKE NETS UPON FISH POPULATIONS OF SOME MASSACHUSETTS PONDS. Transactions of the American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 108-115.

During the period 1951-56, 127,430 pounds of panfish and trashfish have been removed with fyke nets from 45 ponds in Massachusetts in an attempt to improve gamefish populations. Removal has ranged from less than one to 146 pounds per acre annually. Data from four ponds ranging in size from 20 to 269 acres are presented in detail. Where removal was intensive, growth rates of panfish increased markedly. Growth rates of gamefish, especially chain pickerel and largemouth black bass, which were returned to the water, showed a slight decrease or no change. Older panfish, remaining after thinning operations, showed less increase in growth rate than did younger fish spawned during or after the operations. No major changes in species composition in favor of gamefish were apparent. It is concluded that the fyke netting has increased growth rates of the species being thinned but has not materially improved gamefish populations. (Auth. abst.)

1639. Purkett, Charles A., Jr. 1958. GROWTH OF THE FISHES IN THE SALT RIVER, MISSOURI. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 116-131.

Age-and-growth data are presented for 11 species of fish from three habitats in the Salt River, Missouri; a dredged upstream station, an unmodified lower station and an intermediate middle station. The middle station is 46 stream miles from the upper station and 69 stream miles from the lower station. Compared to growth data from the central United States, carp, (Cyprinus carpio) smallmouth buffalo (Ictiobus bubalus), freshwater drum (Aplodinotus grunniens), green sunfish (Lepomis cyanellus) and white sucker (Catostomus commersoni) grew moderately fast; gizzard shad (Dorosoma cepedianum) at an average rate. River carpsucker (Carpiodes carpio) grew very slowly at the upper station and slightly slower than average at the middle and lower stations. Channel catfish (Ictalurus punctatus), flathead catfish (Pilodictis olivaris), northern redhorse (Moxostoma aureolum), and white crappie (Pomoxis annularis) grew slowly. All but one of the more abundant species showed a trend toward faster growth downstream; a phenomonen also noted in other Missouri streams. The differences in growth indicate little movement between stations. Freshwater drum of the 1947 year class were very abundant and they and all freshwater drum competing with them grew slowly. Minimum desirable length for angling in this stream is reached by carp (14 inches), buffalo (12 inches) and white crappie (7 inches) in the third year; green sunfish (6 inches) in the fourth year; and catfishes (12 inches) in the fifth and sixth years. (Auth. abst.)

1640. Ellis, C. H. 1958. REARING METHODS AND THE RETURN OF FALL-MIGRATING CHINOOK SALMON. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 132-138.

Return of planted fin-clipped juveniles of fall-migrating chinook salmon (Oncorhyncus tshawytscha) as 3- and 4-year-old spawners is considered in relation to four different rearing methods. Four groups of salmon, of about 30,000 each were first reared for 78 days in fresh-water and all eventually planted in estuarial waters (salinity about 22 parts per 1,000) at the mouth of the Samish River. Highest return of spawners to the Samish River (0.75 percent) was from juveniles subjected to a 5-day conversion to 75 percent sea water after fresh-water rearing and prior to stocking. Second highest return (0.47 percent) was from fish planted directly after fresh-water rearing. Third highest return (0.26 percent) was from fish subjected to an 8-day conversion to 100 percent sea water followed by 25 days of rearing in sea water. Lowest return (0.19 percent) was from fish handled as the preceding but having a 60-day rearing period in salt water. Sizes of fish in a planting were respectively 150, 150, 49, and 25 to the pound. Rearing in and conversion to salt water was carried out about 30 miles by water from the Samish Hatchery where the fresh-water rearing was done. Migrational timing on return to the Samish River was similar for marked fish and unmarked fish in the run. (Auth. abst.)

1641. LaPointe, Donald F. 1958. AGE AND GROWTH OF THE AMERICAN SHAD, FROM THREE ATLANTIC COAST RIVERS. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 139-150.

Study of age and rate of growth of the American Shad (Alosa sapidissima) in three southeastern coastal rivers (St. Johns River, Florida, Neuse River, North Carolina and Susquehanna River, Maryland) shows similar growth rate in these three streams and a body-scale relationship that can be described

by the parabolic equation, $y = 22.58x^2 + 34.96x + 0.41$. When allowance is made for differences in aging methods, it appears that growth was similar to that reported in the literature for shad from two Canadian populations. Little difference was found in length of males and females of the same age but males matured earlier and were equally more abundant in commercial catches. The annulus appears to be a true year-mark on scales of shad spawning for the first time and results from aging of these fish from scales are not in conflict with known facts about the shad. Spawning marks are considered to be year-marks for "repeater" shad, that is, shad that have spawned more than once, but this has not been validated. (Auth. abst.)

1642. Eisler, Ronald. 1958. SOME EFFECTS OF ARTIFICIAL LIGHT ON SALMON EGGS AND LARVAE. Transactions of The American Fisheries Society Eighty-seventh Annual Meeting, 1957, pp. 151-162.

Eggs and resulting larvae of chinook salmon (Oncorhynchus tshawytscha) were exposed continuously to several intensities of fluorescent light (wave length 3350 to 6000 A. with mean of 5800 A.) for a period extending from 24 hours after fertilization through absorption of the yolk-sac. At an intensity of 157 foot-candles all eggs died before the eyed stage; at 116 foot-candles all eggs died before hatching; and at 88 foot-candles mortality from premature hatching was as much as 35 percent higher than for controls incubated in near-darkness and receiving 0.02 foot-candles. Not more than 37 percent of the eggs exposed to 88 foot-candles hatched, compared to 74 percent for the controls. Most of the larvae of the 88 foot-candle group died by the time the yolk-sac was absorbed compared to a mortality of 30 percent by the controls during a similar period. Chinook salmon eggs under artificial light hatched sooner than those in near-darkness and the larvae from the light-reared group, when compared to the controls, were more sluggish, more darkly pigmented, smaller, and slower in absorbing their yolk-sacs. Of the two experimental lots of chinook eggs, one yellow- and one orange-colored, the yellow eggs hatched more quickly.

Eggs of silver salmon (O. kisutch) were similarly treated. At an intensity of 157 foot-candles all eggs died before hatching and at 86 foot-candles 26.5 percent of the eggs and resulting larvae were dead by the time of first feeding. The control group had a mortality of 9 percent at the time of complete yolk-sac absorption. No difference was noted in size or activity of larvae produced from eggs incubated in light or near-darkness. As with the chinook eggs, an increase in light intensity decreased the number of temperature units required for hatching. (Auth. abst.)

1643. Godfrey, Harold. 1958. A COMPARISON OF SOCKEYE SALMON CATCHES AT RIVERS INLET AND SKEENA RIVER, B.C., WITH PARTICULAR REFERENCE TO AGE AT MATURITY. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 3, pp. 331-354.

Age composition, size and sex data for sockeye salmon catches (1912-1954) at Rivers Inlet and Skeena River, B.C. were compared. For both river systems there were indications of 4- and 5-year cycles of abundance among the 4- and 5-year-old fish, respectively; but the two populations were not necessarily in phase. Tests for correlation between the numbers of parental and offspring fish strongly suggested the dominance of hereditary over environmental influence in determining age at maturity. The two stocks showed much similarity in annual size variation among each sex and age-class. (Auth. abst.)

1644. Hoar, William S., 1958. THE EVOLUTION OF MIGRATORY BEHAVIOUR AMONG JUVENILE SALMON OF THE GENUS ONCORHYNCHUS. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 3, pp. 391-428.

The discussion is based on a detailed ethological comparison of four species of juvenile Oncorhynchus--coho, chum, sockeye and pink salmon. Their behaviour is described in terms of five fixed behaviour patterns--hiding under stones, occupying territories, schooling, feeding and escaping predators. These are performed in relation to five directive factors--light, temperature, current, salinity and objects in the environment. Behaviour patterns and directing factors are associated with characteristic appetitive behaviour. The internal motivation seems to have an endocrinological basis. The coho fry, because of its river habitat, territorial behaviour, low nocturnal activity and smolt transformation, is considered to show behaviour nearest to that of the parental type of the genus. The pink fry has the most highly specialized sea-going behaviour. Three major developments are evident in the evolution of obligatory pelagic and ocean dwelling species (a) early smolt transformation (b) increased nocturnal activity and (c) schooling. Some possible evolutionary sequences are considered. (Auth. abst.)

1645. Tabata, Susumu. 1958. HEAT BUDGET OF THE WATER IN THE VICINITY OF TRIPLE ISLAND, BRITISH COLUMBIA. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 3, pp. 429-451.

Meteorological and oceanographic data from 1947 to 1955 have been analysed and magnitudes of the terms of heat budget equation discussed. Both energy transfer and advective processes are important in the heat budget of water in northern British Columbia. Solar radiation has the largest annual amplitude, the minimum and maximum occurring in winter and summer respectively. Annual amplitude of evaporation is about one-half that of solar radiation, the maximum and minimum also occurring in winter and summer respectively. Heat loss by conduction of sensible heat from the sea is in phase with that by evaporation. Although heat loss by effective back radiation is large (100 g-cal./cm.^{2}/day) the annual amplitude is relatively small. The annual cycle of total heat transfer

across the air-sea boundary is primarily governed by variation of solar radiation, evaporation, and conduction. It is quite marked, with maximum loss (approximately 350 g-cal./cm.^{2}/day) occurring during the short winter period (December, January) and maximum gain (approximately 200 g-cal./cm.^{2}/day) occurring during the long summer period (May to September). There was an apparent 25% loss of heat at the air-sea boundary during the period 1947 to 1954. Losses occurred every year except 1947. Appreciable year-to-year variations occurred in all components of the equation.

The total heat released to the atmosphere by condensation of water vapour is about fivefold that made available by conduction of sensible heat from the sea.

The large discrepancy in the rate of change of heat content of water with rate of heat exchange at the air-sea boundary is attributed to advection. (Auth. abst.)

1646. Strickland, J. D. H. 1958. SOLAR RADIATION PENETRATING THE OCEAN. A REVIEW OF REQUIREMENTS, DATA AND METHODS OF MEASUREMENT, WITH PARTICULAR REFERENCE TO PHOTOSYNTHETIC PRODUCTIVITY. Journal of the Fisheries Research Board of Canada, Vol. 15, No. 3, pp. 453-493.

This review is organized into four sections: (i) definitions and conversion factors, (ii) requirements-photosynthesis, and vision and stimulation by light, (iii) observed distribution of radiant energy, (iv) methods of measurement. It is intended to be introductory rather than comprehensive. Only those aspects of submarine and surface illumination which have a direct bearing on photosynthetic productivity in the sea are discussed in detail and most of the references are European and American in origin.

1647. Sylvester, Robert O., 1958. WATER QUALITY STUDIES IN THE COLUMBIA RIVER BASIN. U. S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report-Fisheries No. 239, 134 pgs.

A brief study has been made of the water quality in the Columbia River Basin. Water quality constituents evaluated were those that might relate to the productivity of the River Basin fishery. The natural water quality of the Basin has experienced a significant change in the past 45 years through the construction of multipurpose and single-purpose dams. After these dams were built, water was available for agriculture, industrial, and domestic consumption. It is the spent waters from these consumptive uses, more than the dams themselves, that have produced this water-quality change. From the standpoint of the fishery, the seemingly most important component of water quality at this time is that of temperature. Water temperatures in the central Columbia and in the lower Snake and Yakima Rivers are quite high during the summer. Dissolved constituents have shown a marked rise during the past 45 years but have not risen to the extent that the fishery is endangered according to data presently available. Dissolved oxygen values are high throughout the Basin with the exception of the lower Willamette River.

This report should be considered as a beginning on a study of the Columbia Basin water quality and not as a report complete in itself. Its principal deficiency is a lack of data on water-temperature changes caused by water impoundment under varying conditions of impoundment. No attempt has been made to evaluate the various water constituents found in their relation to aquatic life. A study of these constituents, present and predicted future, and their relation to aquatic life seems necessary since available data on the subject are meager and conflicting. (Auth. abst.)

1648. Woodmansee, Robert A. 1958. THE SEASONAL DISTRIBUTION OF THE ZOOPLANKTON OFF CHICKEN KEY IN BISCAYNE BAY, FLORIDA. Ecology, Vol. 39, No. 2, pp. 247-262.

A series of zooplankton samples was taken at weekly intervals from November, 1947, to December, 1948, in Biscayne Bay off Chicken Key. The seasonal cycle of the zooplankton was compared to the water temperature, salinity, and local rainfall. The seasonal distribution of the volume of the entire community sampled showed a sustained summer minimum followed by a brief but well-defined maximum in October. The October maximum as well as most of the other plankton volume peaks was composed largely of the copepodids of Acartia tonsa.

The plankton community was composed predominantly of gastropod veligers, copepods and decapod zoeae. Only the copepod population is considered in detail.

The seasonal plankton cycle found in Biscayne Bay is compared to similar cycles found at more northern latitudes along the east coast of the United States. The probable cause of the October zooplankton maximum is discussed. (From auth. summ.)

1649. Welker, W. I. and Jane Welker. 1958. REACTION OF FISH (EUCINOSTOMUS GULA) TO ENVIRONMENTAL CHANGES. Ecology, Vol. 39, No. 2, pp. 283-288.

It is common knowledge that many fish in their natural habitat, or in captivity, will retreat from large objects which are suddenly introduced into their aquatic environment. It is also known that certain fish are very curious and will approach, visually orient toward, and touch novel objects after a period of adaptation. In addition, it is known that fish in aquaria are much more sensitive to environmental changes than they are in the waters of their natural habitat. These sensitive reactions to stimulus changes are inevitable concomitants of laboratory studies of captive animals and cannot be overlooked in the analysis of their behavior.

A study was made of the behavior of Eucinostomus gula to environmental changes. Sixty fish were observed singly in a tank through a one-way-vision screen. The spatio-temporal distribution of the

activity of each fish was studied over a forty-minute period. Fifteen fish were tested by day and fifteen at night on both the first day, and after several days, of captivity. Comparisons of behavior were made before and/or after the environmental changes which consisted of entrance into the observation tank, introduction of an object into the tank, and removal of the object.

It was found that: (a) the initial reaction to such environmental changes consisted of a retreat from the locus of disturbance produced by the object, and marked reduction and inhibition of activity ("freezing"), as well as restriction of activity to a circumscribed spatial locus, (b) during periods of time when no such environmental changes occurred, there was a reversal of these trends; the animals gradually approached the locus where the stimulus change induced by the object occurred and increased their level of activity. As the amount of activity increased, it became distributed over a wider territory, (c) in the ten-minute period during which the object was present in the tank, there was an increase, from first to last, of touches or entries into the object or its immediate vicinity, (d) fish that had been in captivity a few days exhibited lesser activity during the first three minutes following the environmental changes, but during minutes 6-10 following these changes they were more active than the freshly captured fish. The increase in activity (adaptation) following environmental changes occurred more slowly in the newly captured animals, (e) animals tested at night were initially less active than animals tested by day but this difference was reversed during the last 30 minutes of the session, (f) there were wide individual differences in total activity and in activity distribution over time.

These data, together with observations of these animals in the field, suggest that amount of activity is inversely correlated with the degree of novelty of the stimulus situation. (From auth. summ.)

1650. Hasler, Arthur D., and Warren J. Wisby. 1958. THE RETURN OF DISPLACED LARGEMOUTH BASS AND GREEN SUNFISH TO A "HOME" AREA. Ecology, Vol. 39, No. 2, pp. 289-293.

Data are presented which show that displaced green sunfish and largemouth bass return to the site of their original capture, but with varying degrees of success. It is suggested that such things as sex of the individual, number of available territories in the lake or pond, age of the individual, presence or absence of landmarks within the lake or pond, and season of the year could affect the speed and accuracy of return of a displaced fish.

Individual green sunfish in a shallow pond appear to return, in the spring, to the same area occupied the previous summer. Furthermore, it was shown by direct observation of buoyed fish that their return path, after release, is direct and does not include movements that could be described as wandering or random in nature.

Displaced largemouth bass did not return to their capture-area with the same precision as that seen in the green sunfish. It is postulated that this might be partly due to the lack of easily-visible landmarks within the waters of the deeper, rather dark, lakes in which these experiments were conducted, as well as to the longer distances which they had to traverse. It was found, however, that, like the green sunfish, they had maintained their position in the lakes from one summer to another in spite of the intervening winter.

Owing to the non-random behavior of these fish during the summer months, it is suggested that population estimates made during these weeks should be of a design which does not require an assumption of random movement of the members of the population. (Auth. summ.)

1651. Parker, Richard A. 1958. SOME EFFECTS OF THINNING ON A POPULATION OF FISHES. Ecology, Vol. 39, No. 2, pp. 304-317.

Flora Lake, a 41.3-hectare body of water in northern Wisconsin, was the site of a five-year program in which the density of fishes was reduced in an attempt to increase the growth rates of largemouth bass and pan fish. Fyke nets were utilized yearly in removing large numbers of a hybrid and six species, the total quantity removed ranging up to 1125.6 kilograms or 52.5 percent of the catchable standing crop at the time of population estimation in the early summer.

Scale samples, which were collected periodically, were used in the back-calculation of the total length at each annulus. From this data, a pre-treatment growth curve was formulated as were appropriate confidence intervals for the means. It was agreed that the mean, calculated total lengths after 1952 which fell outside of the confidence intervals would be termed significant changes in the rate of growth.

The covariance technique was used to analyze the differences between the slopes of the weight-length regressions and the adjusted, mean weights of specimens collected in 1952 and in 1956.

No important changes occurred in the linear growth rate of largemouth bass; however, in 1956, individuals had a higher adjusted mean weight than in 1952. Bluegills, pumpkinseeds, and hybrids of these two species belonging to recent year classes (1953 and 1954) responded favorably in linear rate of growth after the reduction in their numbers, but only the pumpkinseeds were heavier at the overall mean length. Rock bass exhibited a marked increase in their linear growth rate, particularly members of the 1949, 1950, 1952, and 1953 year classes, even though the total number of rock bass present reached a peak in 1955. A difference could not be demonstrated between their adjusted mean weight in 1952 and in 1956. Yellow perch were thinner and grew more slowly after the initiation of removal operations than they did before. A relatively fast-growing population of white suckers was able to respond to the lowered over-all density in a positive manner, i. e., by growing faster, in spite of a continued rise in their own numbers through 1955. The linear growth rate of golden shiners in Flora Lake did not change, but as among the perch, individuals were lighter at the mean length. Their

population size was thought to be greatly overestimated due to a possibly higher mortality of marked fish. (From auth. summ.)

1652. Hartman, Richard T. 1958. STUDIES OF PLANKTON CENTRIFUGE EFFICIENCY. Ecology, Vol. 39, No. 2, pp. 374-376.

Use of Foerst centrifuge in the manner prescribed by the manufacturer and by standard books on limnological methods removed no more than half of the suspended organic material from the water samples from Pymatuning Reservoir during the height of a summer bloom. Tests conducted indicate the need for three or more runs (6 to 8 minutes per liter per run) through the centrifuge in order to obtain a reasonably accurate estimate of suspended materials.

1653. Hubbs, Clark. 1958. GEOGRAPHIC VARIATIONS IN EGG COMPLEMENT OF PERCINA CAPRODES AND ETHEOSTOMA SPECTABILE. Copeia, 1958, No. 2, pp. 102-105.

In connection with studies of survival rates of North American freshwater fishes and their hybrids, egg complements of many species from various localities have been tabulated. For those species that have adequate data, geographic variation appears to be the rule. Therefore, application of egg counts of fishes in one stream system to total egg production in another, may be hazardous. Data are presented on two darters, Percina caprodes and Etheostoma spectabile. These two species lay eggs several times during each spawning season, as do other darters. The number of eggs produced at one time by a female is chiefly controlled by her size. The frequency of spawning is in large part controlled by water temperature.

1654. Aron, William. 1958. CYTOLOGICAL AND HISTOLOGICAL STUDIES ON THE HYBRID OF PLATICHTHYS STELLATUS X PAROPHRYS VETULUS, WITH NOTES ON ITS BACKCROSS TO P. VETULUS. Copeia, 1958, No. 2, pp. 105-111.

In this study, the gonads and the gonadal products of Inopsetta are compared to the gonads and gonadal products of Parophrys and Platichthys, the supposed parents of Inopsetta.

The data demonstrate that there are far greater variations between the different specimens of the hybrid fish than there are between the alleged parent species. The actual mechanism responsible for these variations is uncertain; however, the abnormalities encountered, i.e., hermaphroditism, clumping of chronosomes, abnormal germ cells, are typical of many reported hybrids. It is difficult to conceive of a true species exhibiting the profoundly abnormal gametogenic processes found in Inopsetta. The evidences remove nearly all doubt of the hybrid nature of Inopsetta.

Although cytological evidence points to the hybrid nature of Inopsetta, it in no way indicates the parent species. Parophrys and Platichthys were used for comparative purposes simply because other workers have suggested them as the progenitors. Histological technique is of little use in determining parental species. Negative results, i.e., the finding of normal gametogenesis, do not necessarily prove that the specimen is a true species. Extensive gametogenic anomalies in a suspected hybrid, however, would certainly strengthen the case for the hybrid origin of the specimen. Also, it must be pointed out that gametogenesis in hybrids may be perfectly normal or only slightly abnormal.

1655. Deubler, Earl E., Jr. 1958. A COMPARATIVE STUDY OF THE POSTLARVAE OF THREE FLOUNDERS (PARALICHTHYS) IN NORTH CAROLINA. Copeia, 1958, No. 2, pp. 112-116.

Postlarvae of Paralichthys from North Carolina waters were studied to determine which species are represented. The late postlarvae of P. dentatus can best be distinguished from those of lethostigma and albigutta by using differences in pigmentary pattern. In addition dentatus differs from the other two species in vertebral count. P. dentatus can also be separated from albigutta by anal ray and dorsal ray counts.

Postlarvae of lethostigma are difficult to separate from albigutta. The only characters found of value were dorsal ray and anal ray counts. (Auth. summ.)

1656. Harrington, Robert W., Jr., and Luis Rene Rivas. 1958. THE DISCOVERY IN FLORIDA OF THE CYPRINODONT FISH, RIVULUS MARMORATUS, WITH A REDESCRIPTION AND ECOLOGICAL NOTES. Copeia, 1958, No. 2, pp. 125-130.

In 1955, a collection of 34 specimens of this species from 6 localities along the Indian River establishes its local habitation and name for the first time since it was described 75 years before. In all, 37 specimens from United States are extant. The species is redescribed, based on the fresh collection.

1657. Arnold, Edgar L., Jr., and John R. Thompson. 1958. OFFSHORE SPAWNING OF THE STRIPED MULLET, MUGIL CEPHALUS, IN THE GULF OF MEXICO. Copeia, 1958, No. 2, pp. 130-132.

Observations of striped mullet spawning offshore in 755 fathoms of water are described. These observations and the collection of several hundred fertilized eggs of this species, several thousand larvae presumably M. cephalus, and post larvae definitely M. cephalus, should establish conclusively that this species does spawn offshore in relatively deep water. This does not exclude the possibility of inshore spawning as well.

1658. Lindsey, C. C. 1958. MODIFICATION OF MERISTIC CHARACTERS BY LIGHT DURATION IN KOKANEE, ONCORHYNCHUS NERKA, Copeia, 1958, No. 2, pp. 134-136.

Two lots of artificially fertilized eggs were hatched under identical conditions with the exception that one lot was subjected to 8 hours of light each day and the other to 16 hours of light. The fry were

held for 45 days following completion of hatching and then preserved.

This experiment shows that the number of caudal vertebrae and probably the number of anal fin rays are subject to alteration by the duration of light exposure during their early development. No immediate applicability to meristic variation of wild kokanee is implied, because no clinal variation has been demonstrated, and because kokanee eggs buried in gravel are probably never exposed to a light intensity comparable to that used experimentally. In fact, the 16-hour exposure may have been deleterious as suggested by the slower development, greater proportion of abnormalities, and higher mortality.

1659. Silliman, Ralph P., and James S. Gutsell. 1958. EXPERIMENTAL EXPLOITATION OF FISH POPULATIONS. U. S. Fish and Wildlife Service, Department of the Interior, Fishery Bulletin 133 of Volume 58, pp. 215-252.

Four laboratory populations of guppies were grown in small aquariums under controlled light, temperature, and food supply. Two of the populations were selected by lot as controls; the other two were used as experimental populations for application of various fishing pressures.

Successive application of fishing rates of 25, 10, 50, and 75 percent per triweekly period produced major changes in the experimental populations not duplicated in the controls. The general effect of exploitation was to produce a decrease in the size of the population, the amount of the decrease varying upward with the exploitation rate, until at the 75-percent rate the test populations were extinguished. Abundance and size composition of the stocks followed classical conceptions derived on theoretical grounds.

Equilibrium yield was found to be related to fishing rate in the manner of a humped curve, with maximal yield at fishing rates between 30 and 40 percent, when the populations were at approximately one-third their asymptotic weight. The yield of fish flesh at the maximum represented about one-fifth the weight of the food consumed.

The conventional fishery measures--catch, catch per unit of effort, and average fish length--were calculated and were found to yield a large amount of information about population size and results of changes in rate of exploitation. (Auth. abst.)

1660. Wilson, Robert C., and Maurice O. Rinkel. 1957. MARQUESAS AREA OCEANOGRAPHIC AND FISHERY DATA, JANUARY-MARCH 1957. U. S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report-Fisheries No. 238, 136 pgs.

This report presents physical, chemical, and biological observations by a 3-vessel survey of the portion of the southeastern Pacific Ocean which is centered in the Marquesas Islands. The expedition was conducted during the southern hemisphere summer, January-March 1957. The methods for field collection of data and laboratory analysis of samples are described. The observed data are presented without analysis. The Hugh M. Smith made physical, chemical, and biological observations in order to define the features of the oceanic circulation and describe the distribution and abundance of phytoplankton and zooplankton. The Charles H. Gilbert made a survey of the stocks of tuna available to live-bait fishing in the Marquesas and Tuamotus, and of the tuna-bait resources in the Marquesas. The John R. Manning made a survey of the deep-swimming tunas available to fishing with longline gear. (Auth. abst.)

1661. Sutherland, Doyle F. 1958. USE OF DIAGNOSTIC X-RAY FOR DETERMINING VERTEBRAL NUMBERS OF FISH. U.S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report-Fisheries No. 244, 9 pgs.

Diagnostic X-ray equipment and supplies are described and methods given for resolving vertebral centri of menhaden larger than approximately one-half inch in length. Only a minimum amount of technical knowledge is necessary to produce satisfactory radiographs from which vertebral counts can be made, thus reducing the time required to determine the vertebral numbers of large samples of fish and forming a fixed impression of the vertebrae which can be conveniently stored for future reference. (Auth. abst.)

1662. Rounsefell, George A. 1958. ANADROMY IN NORTH AMERICAN SALMONIDAE. U. S. Fish and Wildlife Service, Department of the Interior, Fishery Bulletin 131 of Volume 58, pp. 171-185.

Although there is a considerable range of variation in anadromy between species of the same genus, each of the four genera of North American Salmonidae occupies a different position in degree of anadromy exhibited. Arranged in descending order of degree of anadromy, the genera are Oncorhynchus, Salmo, Salvelinus, and Cristivomer.

There is a close correspondence between lethal stream temperatures for the young of certain species and the anadromous habits of those species. (Auth. abst.)

1663. Sanford, F. Bruce, 1958. PLANNING YOUR RESEARCH PAPER. U. S. Fish and Wildlife Service, Department of the Interior, Fishery Leaflet No. 447, 32 pgs.

This manual, which is divided into two main sections, presents suggestions on how to plan your research paper. The first section deals with preliminary steps in planning--such as outlining, choosing headings, and making tables. The second section deals with the various parts of the research paper: title, abstract, table of contents, introduction, acknowledgment, procedure, results and discussion, conclusions, summary, and literature cited.

Stress is laid on the importance of keeping the paper in mind from the moment the research is conceived, of making adequate use of easily understood

tables and illustrations, and of using outlines and headings. Particular attention is focused on the need for stating the specific problem and for orienting the reader to it. Suggestions are given on how to deal with problems in writing the procedure, the results and discussion, and the conclusion. The difference between the conclusion and the summary is made clear, and the relationship between the title and the specific objectives listed in the introduction is pointed out. Finally, a way of avoiding repetition in writing the summary and the abstract is suggested, the question is answered as to whom acknowledgment should be made, and necessary information is given on some of the more clerical aspects of the paper, such as the table of contents and the literature cited. (Auth. abst.)

1664. Tester, Albert L., and Eugene L. Nakamura. 1957. CATCH RATE, SIZE, SEX, AND FOOD OF TUNAS AND OTHER PELAGIC FISHES TAKEN BY TROLLING OFF OAHU, HAWAII, 1951-55. U. S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report--Fisheries No. 250, 25 pgs.

Catch rate, lure preference, size, weight-length relation, sex and maturity, and food data are presented for the following species of fish: skipjack, little tunny, yellowfin, and dolphin. Where available similar data are reported for frigate mackerel, wahoo, and jack. These fishes were caught by trolling off the northeast coast of Oahu, Hawaii, during the period 1951-55.

The following inferences were made: The highest availability for all species combined occurred from May to October; no lure preference was found; the presence of one to several size groups was indicated by the weight distributions for these fishes; weight-length relations indicated a sexual difference in dolphin but not for the others; sex ratios showed a preponderance of males for skipjack, equal proportion of both sexes for little tunny and yellowfin, and a preponderance of females for dolphin, although considerable diversity of sex ratios between schools was observed for the latter; gonad examinations revealed mature specimens for all species except yellowfin; food of these troll-caught fishes consisted primarily of fishes, caphalopods, and crustaceans; interspecific competition for food was indicated. (Auth. abst.)

1665. Stern, Joseph A., Joseph R. Uzmann, and Mary N. Hesselholt. RAPID COUNTING OF NEMATODA IN SALMON BY PEPTIC DIGESTION. U. S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report--Fisheries No. 255, 5 pgs.

The nematode parasite Anisakis sp. can be recovered, relatively unaltered, from chum salmon musculature by high temperature (52° ± 2° C.) peptic digestion of the flesh. The procedure, which is presented in detail, appears to be more thorough in isolating the parasite than dissection of the flesh and manual isolation of the worms. In addition, the precedure is rapid, comparatively simple, economical, and suitable for the examination of large numbers of samples.

The population of Anisakis sp. larvae in chum salmon appears to be concentrated in the ventral section of the fish, that is, below the lateral line, which suggests that only the ventral quarters of the fish need to be examined for estimating infection intensity. (Auth. abst.)

1666. Anderson, William W., and Jack W. Gehringer. PHYSICAL OCEANOGRAPHIC, BIOLOGICAL, AND CHEMICAL DATA--SOUTH ATLANTIC COAST OF THE UNITED STATES, M/V THEODORE N. GILL CRUISE 5. U. S. Fish and Wildlife Service, Department of the Interior, Special Scientific Report--Fisheries No. 248, 220 pgs.

This is the fifth in a series of reports presenting basic data from cruises of the Theodore N. Gill in waters off the South Atlantic coast of the United States.

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